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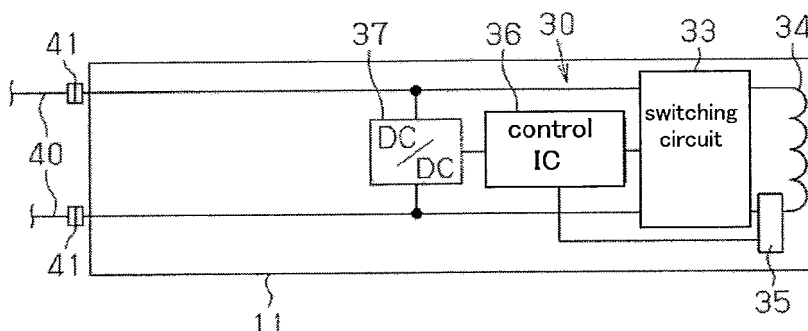
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(54) **Yarn detecting system of spinning machine**

(57) A spinning machine has a plurality of ring plates. A yarn detecting system of the spinning machine includes a yarn detecting unit provided in the ring plate, a main control device and a non-contact power transmission device provided in each ring plate. The yarn detecting unit includes a yarn detecting device having a sensor provided for each spindle and a determining device determining

a state of yarn based on a signal generated by the yarn detecting device. The signal is transmitted by the determining device to the main control device by wireless communication. Non-contact electric power transmission is performed between any two adjacent ring plates. Electric power is supplied to the yarn detecting unit through the non-contact power transmission device.

FIG. 4



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn detecting system of a spinning machine, specifically a yarn detecting system having a yarn detecting device detecting the state of a yarn (e.g. yarn break or loose twist) in a spinning machine having a ring such as a ring spinning machine or a ring twisting machine.

[0002] Generally, a yarn detecting system of the above type is provided with a yarn detecting device for each spindle of the spinning machine. In a ring spinning machine having hundreds of spindles and a main control device handling signals generated by all the yarn detecting devices of the spinning machine, the number of cables and lines in the ring spinning machine becomes large. Japanese Patent Application Publication 2010-111982 discloses a yarn detecting system in a ring spinning machine wherein each ring plate (or ring rail) is provided with a control board having signal cables and a CPU that processes signals generated by sensors. The signals processed by the CPU are transmitted to the main control device through the control board and the signal cables. For the sake of assembling, the ring spinning machine has a plurality of ring plates each provided with twenty-four spindles and the control board forming part of the yarn detecting system. The ring plate may be removed from the spinning machine for maintenance of the ring spinning machine or for changing of the spinning condition, so that the control boards of any two adjacent ring plates are connected to each other by cables having connectors for disconnecting the cables from the ring plates easily.

[0003] Japanese Translation of PCT International Publication 2009-531553 discloses a spinning machine including at least one sensor and one actuator, wherein the sensor detects the operating state of the spinning machine and sends a signal indicative of the operating state to the actuator through wireless communication and the actuator is activated to take action accordingly.

[0004] In the yarn detecting system according to the Japanese Patent Application Publication 2010-111982, when the ring plate is removed from the ring spinning machine for maintenance purpose, the cables connecting between any two adjacent control boards need be removed. It is troublesome and time consuming to remove all the cables. Furthermore, repeated connection and disconnection of the cables may deteriorate or damage the connectors of the cables.

[0005] The yarn detecting system according to the Japanese Translation of PCT International Publication 2009-531553 discloses wireless communication between the sensor and the actuator. However, this Publication gives no consideration to how electric power is supplied to the sensors and their controls. The present invention which has been made in light of the above problems is directed to providing a yarn detecting system of

a spinning machine that makes it unnecessary to remove signal cables and power transmission cables between yarn detecting units in removing ring plates.

SUMMARY OF THE INVENTION

[0006] A spinning machine has a plurality of ring plates. A yarn detecting system of the spinning machine includes a yarn detecting unit provided in the ring plate, a main control device and a non-contact power transmission device provided in each ring plate. The yarn detecting unit includes a yarn detecting device having a sensor provided for each spindle and a determining device determining a state of yarn based on a signal generated by the yarn detecting device. The signal is transmitted by the determining device to the main control device by wireless communication. Non-contact electric power transmission is performed between any two adjacent ring plates. Electric power is supplied to the yarn detecting unit through the non-contact power transmission device.

[0007] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

FIG. 1A is a schematic plan view showing the relation between ring plates and yarn detecting devices of a yarn detecting system in a ring spinning machine according to a preferred embodiment;

FIG. 1B is a schematic circuit diagram showing the electric power transmission between the yarn detecting units provided for any two adjacent ring plates of FIG. 1A;

FIG. 2 is a schematic cross-sectional view showing the positional relation between a ring and a yarn detecting device in the yarn detecting system of FIG. 1A;

FIG. 3 is a schematic cross-sectional view showing a control board that is fixed to a support member of the yarn detecting device of FIG. 1;

FIG. 4 is a schematic diagram of a circuit provided on a ring plate located at one end of the ring spinning machine according to the embodiment wherein electric power is supplied from a power source to electric components on the ring plate;

FIG. 5 is a schematic diagram of a circuit provided on the ring plate located at one end of a ring spinning

machine according to an alternative embodiment of the present invention wherein electric power is supplied from a power source to a power receiving coil on the ring plate; and

FIG. 6 is a schematic circuit diagram showing the positional relation between a power supply coil and a power receiving coil on a ring plate located at one end of a spinning machine according to another alternative embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] The following will describe the yarn detecting system of a ring spinning machine according to the preferred embodiment with reference to FIGS. 1 through 4. The ring spinning machine includes a plurality of ring plates 11 that are arranged in two rows. For the sake of ease of assembling, the spinning machine is so configured that each ring plate 11 includes twenty-four spindles. For example, when the ring spinning machine includes four hundreds eighty spindles, two rows of ring plates 11 each including ten ring plates 11 are arranged one behind the other. When the ring spinning machine includes nine hundreds sixty spindles, twenty ring plates 11 are arranged in each row.

[0010] As shown in FIG. 1A, each ring plate 11 has a plurality of rings 12 which are arranged in a line at a predetermined spaced interval and fixed to the ring plate 11. As shown in FIG. 2, the ring 12 has a ring flange 12A and a traveler 13 is slidably mounted to the ring flange 12A.

[0011] A yarn detecting unit 16 is provided for each ring plate 11. The yarn detecting unit 16 includes a plurality of yarn detecting devices 14 that are provided for the respective spindles and a CPU 15 (shown in FIG. 3). The yarn detecting device 14 has a sensor 14A detecting the state of a yarn at each spindle and generating a signal indicative of the detected state of yarn. The CPU 15 determines the state of yarn according to the signal from the sensor 14A. Specifically, the signals generated by the twenty-four sensors 14A of the yarn detecting devices 14 are processed by the CPU 15, which determines the state of yarns (or yarn break) at the twenty-four spindles. The CPU 15 is provided on a control board 17 that is provided on the front of the ring plate 11. It is noted that the front and the rear of the ring plate 11 correspond to the lower side and the upper side of the ring plate 11 as viewed in FIG. 1A, respectively. The CPU 15 serves as the determining device of the present invention. As shown in FIGS. 2 and 3, the ring plate 11 has a front wall 11A and a hole 11B formed through the ring plate 11. A support member 18 is fixed to the front wall 11A of the ring plate 11 and extending in the longitudinal direction of the ring plate 11. The support member 18 has formed therein an accommodating space 18A (shown in FIG. 3). In the present embodiment, the control board 17 is not fixed to the ring plate 11 directly but supported by the support member 18 in the accommodating space 18A

thereof.

[0012] The yarn detecting device 14 is operable to generate a detection signal without receiving electric power from outside. As shown in FIG. 2, the yarn detecting device 14 includes the sensor 14A detecting the traveler 13 and a case 19 accommodating therein the sensor 14A. The case 19 includes a mounting plate 19A on which the sensor 14A is fixed and a cover 19B fixed to the mounting plate 19A for protecting the sensor 14A. The cover 19B is made of a non-magnetic material such as a stainless material or a plastic. The yarn detecting device 14 of the present invention has a similar structure as the yarn detecting device of Japanese Patent Application Publication 2010-111982. The mounting plate 19A is fixed to the ring plate 11 by a fixing member 20 that is inserted through the hole 11B formed through the ring plate 11 and a hole 19C formed through the mounting plate 19A. The fixing member 20 is formed in a shape of a bolt and has formed therethrough a hole extending axially in the center of the fixing member 20. The case 19 is fixed to the ring plate 11 by the fixing member 20 and a nut.

[0013] Though not shown in the drawing, the sensor 14A includes a magnetic yoke made of a magnetic material, a disk-shaped permanent magnet and a pickup coil wound around the magnetic yoke, all of which are molded by a plastic. A flexible cable 21 is electrically connected to the pickup coil and extends from the sensor 14A. As shown in FIG. 3, the flexible cable 21 has at one end thereof a connector 21A. The traveler 13 is made of a magnetic material and movable over the ring 12. A magnetic circuit passing through the ring plate 11, the ring 12 and the magnetic yoke is formed by the magnetic flux generated by the permanent magnet and flowing from N to S poles of the permanent magnet.

[0014] The pickup coil detects the movement of the traveler 13 by the electromagnetic induction generated by the movement of the traveler 13 traversing the magnetic circuit.

[0015] The control board 17 has a printed circuit (not shown) for transmitting detection signals generated by the sensor 14A of the yarn detecting device 14 to the CPU 15. As shown in FIG. 3, the printed circuit is electrically connected to a flexible cable 22 having a connector 22A that is connectable to the connector 21A. Thus, the signal of the yarn detecting device 14 can be transmitted to the CPU 15.

[0016] The CPU 15 of the yarn detecting unit 16 is configured to transmit to a main control device 23 (shown in FIG. 1A) the signals processed by the CPU 15. The transmission of the signals from the CPU 15 to the main control device 23 is performed by wireless communication. The main control device 23 that is included in the yarn detecting system controls the operation of the entire ring spinning machine. Specifically, the main control device 23 is operable to transmit control signals to various drive units of the ring spinning machine according to the predetermined spinning conditions, receive data representing the state of a yarn at each spindle from the CPUs 15 of the

respective yarn detecting units 16 and control the respective drive units so as to control the operation of the spinning machine according to the desired spinning conditions. Wireless signal communication may be accomplished by using any known method such as Bluetooth, ZigBee or wireless LAN (or WLAN).

[0017] As shown in FIG. 1B, each ring plate 11 is provided with a non-contact power transmission device 30 through which electric power transmission is performed between any two adjacent ring plates 11. The non-contact power transmission device 30 is included in the yarn detecting system. Specifically, the non-contact power transmission device 30 in each ring plate 11 includes a power-receiving coil 31, a rectifier circuit 32 connected to the power-receiving coil 31, a switching circuit 33 connected to the output of the rectifier circuit 32, a power-transmitting coil 34 connected to the output of the switching circuit 33 and a current detection circuit 35 detecting current flowing through the power-transmitting coil 34.

[0018] Current is supplied to the power-transmitting coil 34 through the switching circuit 33 that is controlled by a control IC 36. In the embodiment, a single-phase DC/AC converter is used as the switching circuit 33. A DC/DC converter 37 is provided between the rectifier circuit 32 and the switching circuit 33 for converting the output voltage of the rectifier circuit 32 to a voltage that is usable by the control IC 36. The converted voltage is supplied to the control IC 36. For example, the output voltage of the rectifier circuit 32 is about 40V and the DC/DC converter 37 converts 40V into about 4V.

[0019] The control IC 36 controls the duty ratio of the switching circuit 33 according to the change of current flowing through the power-transmitting coil 34. Specifically, a map or a relational expression indicative of the relation between the current flowing through the power-transmitting coil 34 and the consumption power on the power receiving side is stored in a memory of the control IC 36. A detection signal generated by the current detection circuit 35 is transmitted to the control IC 36 and the control IC 36 controls the duty ratio of the switching circuit 33, accordingly, so that the current flows to the power-transmitting coil 34 according to the consumption power on the receiving side. It is noted that the control IC 36 performs also the function of the CPU 15 in the embodiment.

[0020] The power-receiving coil 31 is provided on the ring plate 11 at a position adjacent to one end of the ring plate 11 and also to a power supply coil (not shown) and the power-transmitting coil 34 is provided on the ring plate 11 at a position adjacent to the other end of the ring plate 11 and far from the power supply coil (not shown). In the embodiment, the power supply coil is provided at a position adjacent to the left end of the ring plate 11 as viewed in FIG. 1B, so that the power-receiving coil 31 is located at the left end of the ring plate 11 and the power-transmitting coil 34 at the right end of the ring plate 11, respectively.

[0021] As shown in FIG. 4, DC power of a predeter-

mined voltage is supplied from the power supply (not shown) through a flexible cable 40 to the non-contact power transmission device 30 on the ring plate 11 that is located at one end of the ring spinning machine. The flexible cable 40 is movable up and down integrally with the ring plate 11 without receiving excessive force. The flexible cable 40 has a connector 41 which allows the flexible cable 40 to be disconnected from the ring plate 11.

[0022] The following will describe the operation of the above-described yarn detecting system. Magnetic flux that is generated by the permanent magnet embedded in the sensor 14A and directed from N to S poles of the permanent magnet forms a magnetic circuit passing through the ring plate 11, the ring 12 and the magnetic yoke. In operation of the ring spinning machine, when a cop (not shown) is rotated in accordance with the rotation of the spindle (not shown), the traveler 13 continues to move in slide contact with the ring flange 12A at a speed corresponding to the rotating speed of the cop if no yarn break occurs. Each time the traveler 13 makes a complete turn along the ring flange 12A, the traveler 13 traverses the magnetic circuit and a pulse voltage is generated across the opposite ends of the pickup coil in synchronization with the turn of the traveler 13. In the event of a yarn break, the pulse voltage fails to be generated across the pickup coil in synchronization with the turn of traveler 13.

[0023] The CPU 15 (or the control IC 36) receives signals continually from the twenty-four sensors 14A and determines that yarn spinning is being performed normally if the pulse voltage is generated continually and determines that yarn break has occurred if the pulse voltage generation is interrupted. Based on the control signal from the main control device 23, the CPU 15 provided for each control board 17 informs the main control device 23 of the presence of a yarn break and of the location (or the number) of the spindle having the yarn break. The main control device 23 determines the state of a yarn at each spindle based on the signals from the CPU 15.

[0024] Referring to FIG. 4, the total electric power required for all the yarn detecting units 16 is supplied in the form of DC power from the power supply to the switching circuit 33 without flowing through the power-receiving coil 31 and the rectifier circuit 32. Based on the data of the map and the relational expression stored in the memory, the control IC 36 controls the duty ratio of the switching circuit 33 so that the current flows to the power-transmitting coil 34 in accordance with the requirement of the consumption power on the receiving side. The control IC 36 determines the amount of current transmitted to the power-transmitting coil 34 according to the signal generated by the current detection circuit 35. In response to a change of the amount of current, the control IC 36 controls the duty ratio of the switching circuit 33 so that the current flows to the power-transmitting coil 34 in accordance with the requirement of the consumption power on the receiving side.

[0025] The power-receiving coil 31 that is provided in any other ring plate 11 than the ring plate 11 to which DC power is supplied through the flexible cable 40 receives electric power generated by the electromagnetic induction from the power-transmitting coil 34 in the preceding ring plate 11 as viewed in the direction of power transmission. The electric power received is rectified by the rectifier circuit 32 and supplied to the switching circuit 33. Subsequently, the control IC 36 controls the switching operation of the switching circuit 33 under the predetermined duty ratio so that the current flows to the power-transmitting coil 34 in accordance with the consumption power requirement on the receiving side, with the result that the electric power is transmitted to the power-transmitting coil 34.

[0026] The ring plate 11 is occasionally removed from the ring spinning machine for the maintenance thereof or when the spinning condition is changed. In this case, the flexible cable 40 is removed from the ring plate 11 by disconnecting the connector 41 of the flexible cable 40 from the connector 41 on the ring plate 11 side. Subsequently, the ring plate 11 is removed from the ring spinning machine. The ring plate 11 can be removed from the ring spinning machine easily without disconnecting signal cables and cables for power transmission between any two adjacent ring plates 11 as in the case of the prior art yarn detecting system, because there is no signal cable and no cable for power transmission between any two adjacent ring plates 11 in the yarn detecting system in the ring spinning machine according to the present embodiment.

[0027] The yarn detecting system of the ring spinning machine according to the embodiment offers the following advantageous effects.

(1) The yarn detecting system includes a plurality of the yarn detecting units 16 for each ring plate 11 of the ring spinning machine. Each yarn detecting unit 16 includes a plurality of the yarn detecting devices 14 provided for each spindle and the determining device (or the CPU 15) determining the state of a yarn at each spindle based on the signal generated by the sensor 14A of the yarn detecting device 14. Signal transmission between the CPU 15 and the main control device 23 is conducted by wireless communication. Each ring plate 11 is provided with the non-contact power transmission device 30 which allows non-contact power transmission between any two adjacent ring plates 11. Electric power is supplied to the respective yarn detecting units 16 through the non-contact power transmission device 30, so that cables for power transmission and signal cables are dispensed with. Therefore, no working is required for disconnecting signal cables and cables for power transmission between any two adjacent yarn detecting units 16 when the ring plates 11 are removed and also for connecting the cables when the ring plates 11 are assembled.

(2) The non-contact power transmission device 30 transmits electric power by the electromagnetic induction between the power-transmitting coil 34 provided on the power-transmitting side and the power-receiving coil 31 on the power-receiving side. As compared with any non-contact power transmission using optical communication or static induction, the non-contact power transmission by the electromagnetic induction is barely affected by cotton fly and hence suitable for the use in a ring spinning machine.

(3) Electric power is supplied to the power-transmitting coil 34 through the switching circuit 33 whose duty ratio is controlled by the control IC 36 according to the change of the amount of current flowing through the power-transmitting coil 34. In the embodiment, the relation between the amount of current on the power-transmitting side and power consumption on the power-receiving side is figured out preliminarily, the duty ratio of the switching circuit 33 is changed according to the change of the amount of current on the power-transmitting side and the voltage on the power-receiving side is controlled to be constant, so that a feedback circuit from the power-receiving side to the power-transmitting side can be omitted, with the result that the entire circuit can be simplified and the area where components are mounted may be minimized.

(4) The yarn detecting device 14 in the embodiment according to the present invention can generate detection signals without receiving electric power from outside. If an optical sensor or a sensor operable by the electrostatic induction that needs electric power is used for detecting a yarn, power consumption for yarn detection at each spindle may be small, but the electric power that is transmitted by non-contact power transmission increases due to the large number of spindles of a ring spinning machine and the yarn detecting system grows in size, accordingly. However, the yarn detecting device 14 of the yarn detecting system according to the embodiment can transmit a detection signal without receiving electric power, so that the yarn detecting system can be prevented from growing in size.

(5) The ring plate 11 that is located at one end of the ring spinning machine has neither power-receiving coil 31 nor rectifier circuit 32 and is configured so that DC power is supplied through the flexible cable 40 from the power supply to the ring plate 11. The flexible cable 40 can be moved up and down integrally with the ring plate 11 without receiving any excessive force. As compared with the other ring plates 11 that are provided with the power-receiving coil 31, the rectifier circuit 32 and the power supply coil to which AC power is supplied from the power supply, the structure of the above ring plate 11 lo-

cated at one end of the ring spinning machine can be made simplified.

(6) In the illustrated embodiment, a single phase DC/AC converter is used as the switching circuit 33. Though, according to the present invention, a three phase DC/AC converter may be used as the switching circuit 33, the single phase DC/AC converter is advantageous over the three phase converter in downsizing of the non-contact power transmission device 30.

(7) The control IC 36 forming a part of the non-contact power transmission device 30 performs also the function of the CPU 15 that serves as the determining device of the yarn detecting unit 16, so that the structure of the non-contact power transmission device 30 can be simplified as compared with a case wherein the control IC 36 and the CPU 15 are provided separately.

(8) It is so configured that the output voltage of the rectifier circuit 32 is higher than the voltage used for the control IC 36. Therefore, voltage that is used for the control IC 36 need be reduced through the DC/DC converter 37, but it is easy to supply power to the power-receiving coil 31 of the non-contact power transmission device 30 provided on the adjacent ring plate 11.

[0028] The present invention is not limited to the embodiment described above, but it may be modified into various embodiments as exemplified below.

- Instead of DC power, AC power may be supplied to the non-contact power transmission device 30 in the ring plate 11 arranged at one end of the ring spinning machine. For example, as shown in FIG. 5, a power supply coil 38 may be detachably fixed to the ring plate 11 arranged at one end of the ring spinning machine through a support member 39. The support member 39 is fixed to the ring plate 11 by any suitable fastening means (not shown). AC power is supplied from a power supply (not shown) to the power supply coil 38 through the flexible cable 40. The power supply coil 38 supplies electric power to the power-receiving coil 31. The power supply coil 38 and the flexible cable 40 are movable up and down integrally with the ring plate 11 without receiving any excessive force.
- Instead of the structure wherein the power supply coil 38 is fixedly mounted to the ring plate 11 through the support member 39, a lifter for lifting and lowering the power supply coil 38 in synchronization with the ring plate 11 may be provided. Alternately, the power supply coil 38 may be fixedly disposed at a position corresponding to the center in the moving range of

the ring plate 11.

- Power supply (power transmission) to each of the yarn detecting units 16 in the ring plates 11 arranged in a line on each side of the ring spinning machine may not necessarily be performed from the power supply coil 38 provided at one end of the ring spinning machine. The ring plates 11 may be divided into a plurality of groups and the power may be supplied from the power supply coil such as 38 on the ring plate 11 that is located at one end of each group. For example, the ring plates 11 may be divided into two groups and the power supply coils 38 are provided on the ring plates located at opposite ends of the ring spinning machine. In such a case, each power supply coil 38 may be fixed to the ring plate 11 or, alternatively, mounted so as to be movable up and down by a lifter for lifting and lowering the power supply coil 38. It may be so configured that power is supplied to the yarn detecting units 16 provided in the ring plates 11 of one of the two groups from the power supply coil 38 provided in one end of the ring spinning machine and power is supplied to the yarn detecting units 16 provided in the ring plates 11 of the other group from the other power supply coil 38 provided in the other end of the ring spinning machine. When the number of ring plates 11 is even, the ring plates 11 are divided simply into halves, and when the number of ring plates 11 is odd, the ring plates 11 are divided so that the number of ring plates 11 in one group is larger than the other group by one.
- When the ring plates 11 arranged in a line are divided into three groups or more, the power-receiving coil 31 and the power supply coil 38 of the non-contact power transmission device 30 that receives power through the flexible cable 40 and is provided on a ring plate 11 of an intermediate group are disposed in a different arrangement from those of the other non-contact power transmission devices 30 of the other groups. As shown in FIG. 6, the power supply coil 38 and the power-receiving coil 31 are disposed in such an arrangement that the axes of the power supply coil 38 and the power-receiving coil 31 extend in the longitudinal direction of the ring plate 11. Though the power supply coil 38 and the power-receiving coil 31 may be so arranged that the power supply coil 38 and the power-receiving coil 31 are oriented with the axes thereof extending in a direction perpendicular to the longitudinal direction of the ring plate 11, the former arrangement is advantageous in that a space is ensured for the flexible cable 40 to move when the flexible cable 40 connected to the power supply coil 38 is moved in accordance with the up and down movement of the power supply coil 38. The power-transmitting coil 34 need be positioned at the end of the ring plate 11 that is opposite from the power-receiving coil 31 and the power sup-

ply coil 38. It is noted, however, that the power-receiving coil 31 and the power supply coil 38 need not necessarily be positioned at the end of the ring plate 11 as shown in FIG. 6. The power-receiving coil 31 and the power supply coil 38 may be positioned at the longitudinal center or at a position adjacent to the longitudinal center of the ring plate 11 by shortening the distance between the rectifier circuit 32 and the switching circuit 33. In such a case, printed wirings connecting between the power-receiving coil 31 and the rectifier circuit 32 and also between the rectifier circuit 32 and the switching circuit 33 can be shortened.

- The power supply coil 38 may be permanently fixed to the ring plate 11 without using the support member 39 that allows detachable mounting, and is connected to the power supply through a flexible cable having a connector.

[0029] In such a case, the ring plate 11 is removed from the ring spinning machine by disconnecting the connector of the flexible cable from the power supply coil 38.

- In a large-size ring spinning machine having approximately one thousand spindles, the driving unit may be provided at the center of the ring spinning machine and the spinning units on the opposite sides thereof, respectively. In such a case, the ring plates 11 are divided into two groups with the driving unit positioned therebetween and arranged in a line in the longitudinal direction of the ring spinning machine at a predetermined spaced distance. Electric power is supplied to the yarn detecting units 16 on the ring plates 11 in a manner of wireless power transmission by using the above-described non-contact power transmission devices 30.
- The yarn detecting device of the yarn detecting system of the embodiment may be used for detecting whether or not the yarn is loosely twisted, as well as a yarn break, based on a signal generated by the sensor 14A. The detection of a loose twist of a yarn may be accomplished by counting the number of pulse signals generated per unit time by the sensor 14A in accordance with the number of turns of the traveler 13, calculating the number of turns of the traveler 13 per unit time, calculating the number of twists of the yarn from the number of turns of the traveler 13 and the spinning speed, and then comparing the calculated number of twists with a predetermined number of twists.
- The sensor 14A of the yarn detecting device 14 is not limited to the structure as described with reference to the above embodiment. For example, the sensor 14A may be made of a magnetic yoke and a pickup coil wound around the magnetic yoke, which

are molded by resin, and the traveler 13 may be made of a permanent magnet. In such a case, the CPU 15 determines the presence of a yarn break or a loose twist of a yarn from a change of detection signals that are produced by electromagnetic induction due to the change of the distance between the pickup coil and the traveler 13 moving along the ring flange 12A.

- The non-contact power transmission device is not limited to the structure wherein electric power is transmitted by electromagnetic induction between the power-transmitting coil 34 and the power-receiving coil 31. For example, electric power may be transmitted by optical communication, static induction or magnetic field resonance.
- The yarn detecting device according to the present invention is not limited to the structure as described with reference to the embodiment, but may be of a type that needs to receive electric power. For example, the yarn detecting device may be an external photoelectric effect type photosensor or a static induction type sensor.
- The CPU 15 as the determining device and the control IC 36 may be provided separately.
- The control IC 36 may be connected directly between the rectifier circuit 32 and the switching circuit 33 without the provision of the DC/DC converter 37. In such a case, the power-receiving coil 31 is configured so that electric power received in the power-receiving coil 31 and then rectified by the rectifier circuit 32 has a voltage that is suitable for the control IC 36.
- The switching circuit 33 is not limited to a single-phase DC/AC converter, but it may be a three-phase DC-AC converter.
- In the embodiment, the current detection circuit 35 detects the current flowing through the power-transmitting coil 34 and the duty ratio of the switching circuit 33 is changed based on the detected current. However, the switching circuit 33 may be driven with a predetermined duty ratio.
- The DC/DC converter 37 may be replaced by a regulator, e.g. a three-terminal regulator.
- The yarn detecting device 14 need not be provided for each ring 12, but the sensor 14A may be provided for each spindle. For example, one yarn detecting device 14 having two sensors 14A may be provided for each two rings 12 or, alternatively, one yarn detecting device 14 having more than two sensors 14A may be provided for each three or more rings 12.

- Without the provision of the support member 18, the control board 17 may be fixed to the front wall 11A of the ring plate 11 directly by a fastener screwed into a threaded hole in the front wall 11A or by a nut and a bolt passed through a hole formed through the front wall 11A. 5
- The number of rings 12 provided in one ring plate 11 is not limited to twenty-four, but may be more or less than twenty-four. 10
- Instead of the structure wherein all the signals generated by the sensors 14A of the yarn detecting devices 14 provided in one ring plate 11 are processed by one CPU 15 provided in each control board 17, the signals may be processed by a plurality of CPUs 15 provided in the respective control boards 17. 15
- The CPU 15 dealing with the yarn detecting devices 14 may be configured only to receive and send signals indicative of the state of a yarn. That is, the CPU 15 may be dispensed with the function of determining the state of a yarn. In such a case, the determining function may be performed by a separate control device or by main control device 23 of the ring spinning machine. Alternatively, the main control device 23 may receive signals from the CPU 15 and determine the state of a yarn such as a yarn break. In such a case, the separate control device or the main control device 23 of the ring spinning machine serves as the determining device of the present invention. 20 25 30
- The yarn detecting device 14 may not include necessarily the mounting plate 19A and the cover 19B that covers the mounting plate 19A and the sensor 14A but may include the sensor 14A that is integrally formed with the mounting plate 19A without the cover 19B. 35
- The ring plate 11 is not limited to be U-shaped in cross-section, but may be crank-shaped so that the yarn detecting device 14 is fixed to the rear wall of the ring plate 11. 40
- The spinning machine is not limited to a ring spinning machine. The present invention is applicable to a ring spinning machine provided with a plurality of ring plates 11, such as a ring twisting machine. 45

Claims

1. A yarn detecting system of a spinning machine wherein the spinning machine has a plurality of ring plates (11), **characterized in that** the yarn detecting system includes: 55

a yarn detecting unit (16) provided in the ring

plate (11), wherein the yarn detecting unit (16) includes a yarn detecting device (14) having a sensor (14A) provided for each spindle and a determining device (15) determining a state of yarn based on a signal generated by the yarn detecting device (14);
a main control device (23), wherein the signal is transmitted by the determining device (15) to the main control device (23) by wireless communication; and
a non-contact power transmission device (30) provided in each ring plate (11), wherein non-contact electric power transmission is performed between any two adjacent ring plates (11), wherein electric power is supplied to the yarn detecting unit (16) through the non-contact power transmission device (30).

2. The yarn detecting system of a spinning machine according to claim 1, **characterized in that** the non-contact power transmission device (30) further includes:

a power-transmitting coil (34) provided on power-transmitting side of the non-contact power transmission device (30); and
a power-receiving coil (31) provided on power-receiving side of the non-contact power transmission device (30), wherein electric power is transmitted by electromagnetic induction between the power-transmitting coil (34) and the power-receiving coil (31).

3. The yarn detecting system of a spinning machine according to claim 2, **characterized in that** the non-contact power transmission device (30) further includes:

a switching circuit (33) through which current is supplied to the power-transmitting coil (34); and
a control IC (36) controlling the duty ratio of the switching circuit (33) according to a change of amount of current transmitted to the power-transmitting coil (34).

4. The yarn detecting system of a spinning machine according to any one of claims 1 through 3, **characterized in that** the yarn detecting device (14) can generate the signal without receiving electric power.

5. The yarn detecting system of a spinning machine according to any one of claims 1 through 4, **characterized in that** the yarn detecting system further includes:

a power supply coil (38) supplying electric power to the non-contact power transmission device (30) and provided so as to be movable up and

down integrally with the ring plate (11).

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FIG. 1A

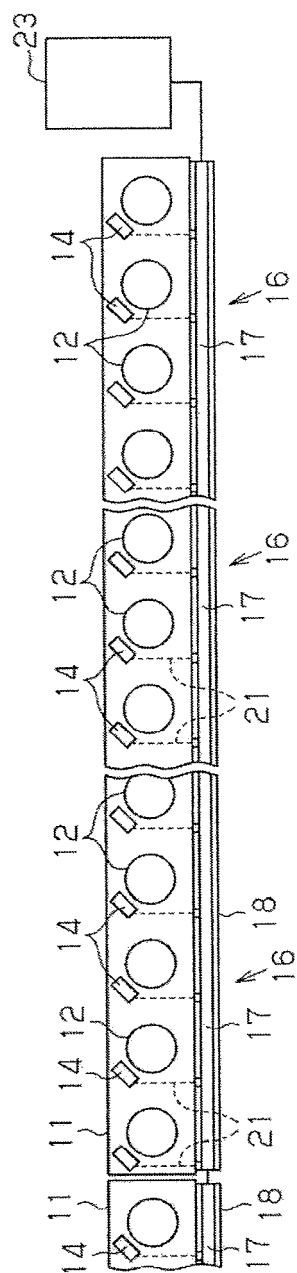


FIG. 1B

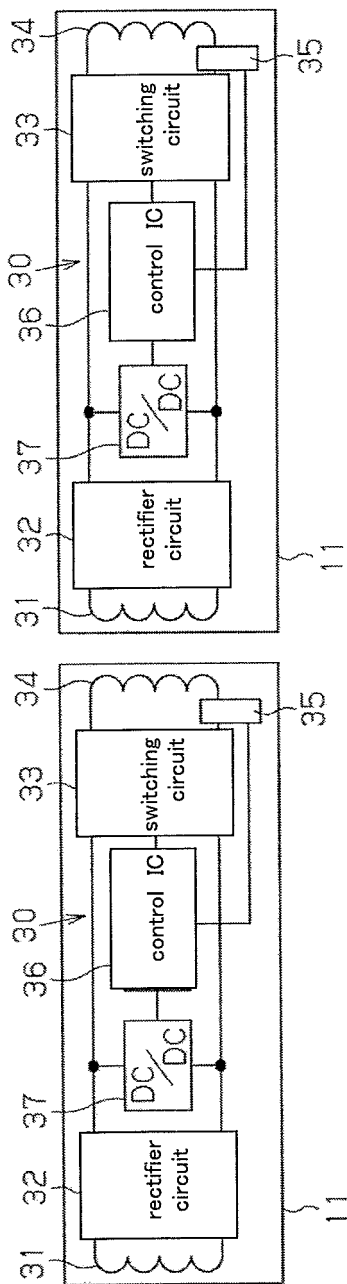


FIG. 2

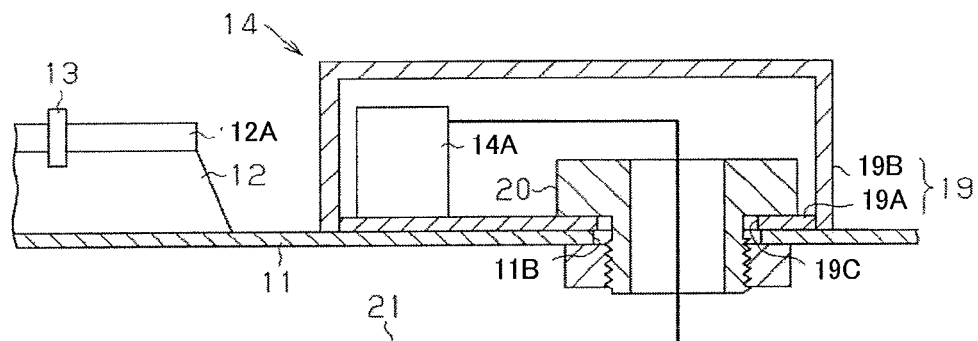


FIG. 3

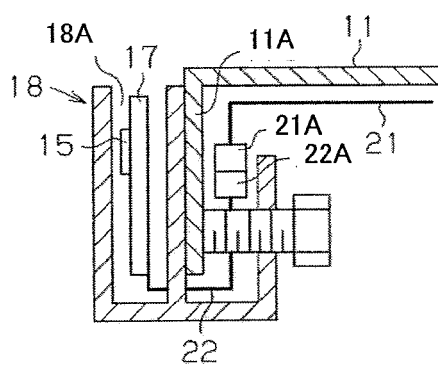


FIG. 4

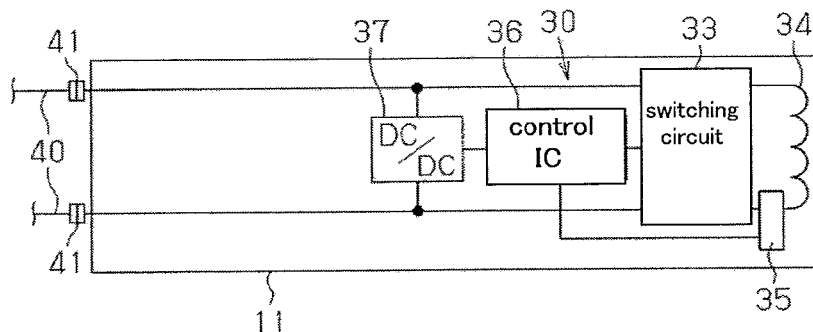


FIG. 5

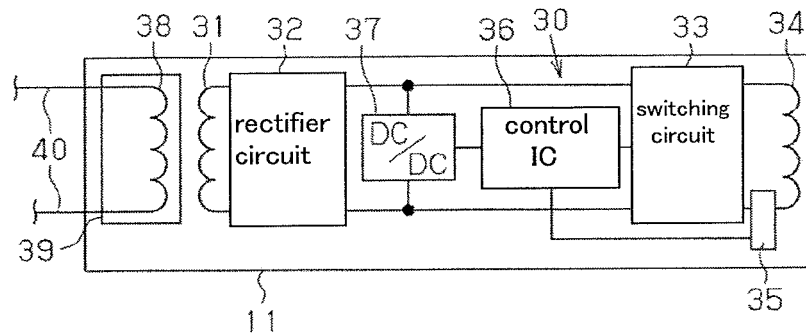
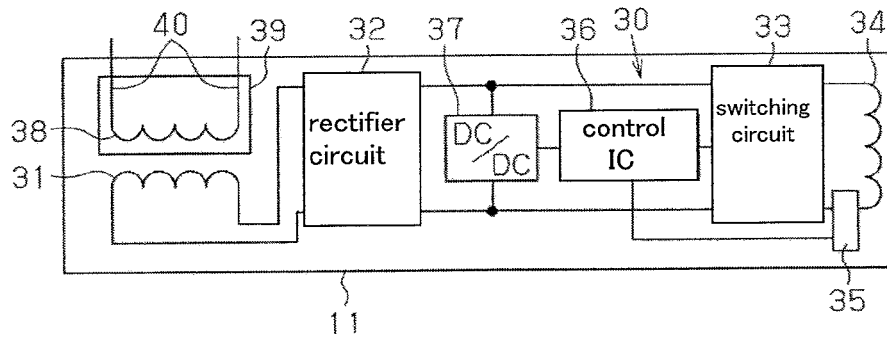


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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