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

(57) A yarn detecting system for a spinning machine includes a plurality of yarn detecting units, a signal transmitter and a signal receiver. Each ring plate is provided for a plurality of spinning stations. The yarn detecting unit is provided for each ring plate and includes a plurality of yarn detecting devices which is provided for the respective spinning stations and each of which includes a sensor and generates a detection signal indicative of a state of

yarn at the spinning station and a determining device which determines the state of the yarns according to the detection signals and generates first pulse signals representing the state of the yarns. Signal transmission is performed from the determining device to the main controller and the signal transmission between the signal transmitter and the signal receiver provided between the adjacent ring plates is performed in a non-contact manner.

FIG. 1A

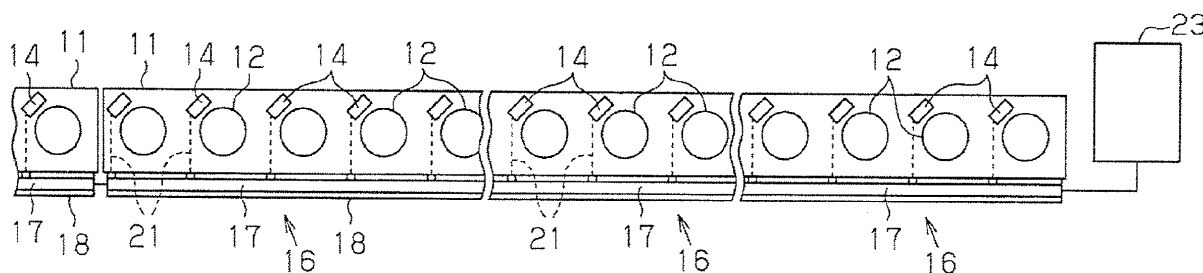
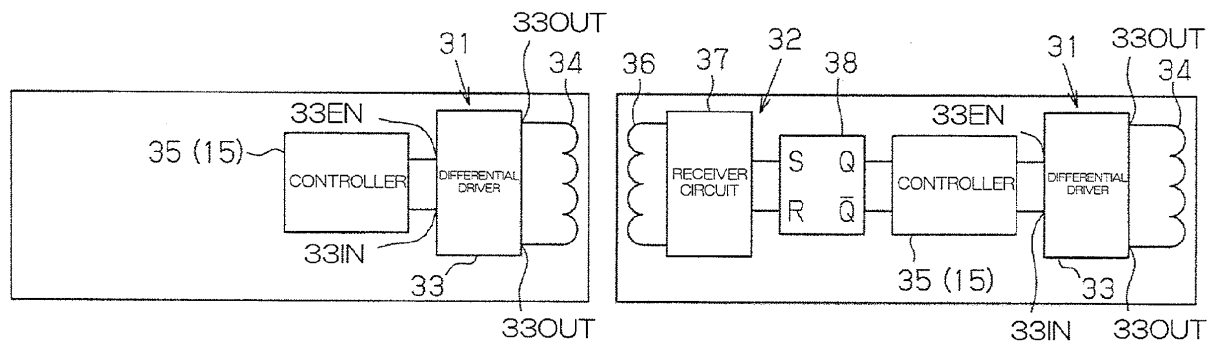


FIG. 1B



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn detecting system for a spinning machine, more particularly, to a yarn detecting system which detects the state of a yarn, e. g. a yarn break or a loose twist in a spinning machine having a ring, such as a ring spinning machine or a ring twisting machine.

[0002] Generally, such yarn detecting system has sensors each provided for each spinning station of the spinning machine. A ring spinning machine has hundreds of spinning stations and a main controller mounted on a base of the ring spinning machine and handling detection signals generated by all the sensors of the ring spinning machine. Such a ring spinning machine requires a large number of cables and lines for the yarn detecting system. Japanese Patent Application Publication No. 2010-111982 discloses a yarn detecting system in a ring spinning machine wherein each ring plate of the ring spinning machine is provided with a control board having signal cables and a CPU that processes detection signals generated by sensors. The detection signals processed by the CPU are transmitted to the main controller of the ring spinning machine 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 spinning stations and the control board of the yarn detecting unit is provided for each ring plate. The ring plate is removed from the ring spinning machine for maintenance of the ring spinning machine or for changing of the spinning conditions, so that cables having connectors are used for easy connection of the control boards of any two adjacent ring plates.

[0003] Japanese Translation of PCT International Publication No. 2009-531553 discloses a spinning machine having at least one sensor and one actuator, wherein the sensor detects the operating state of the spinning machine and transmits to the actuator by wireless communication a detection signal indicative of the operating state of the spinning machine so that the actuator is operated to take action accordingly.

[0004] In the yarn break detecting system according to the Publication No. 2010-111982, when the ring plates are removed from the base of the ring spinning machine for maintenance purpose, the cables connecting between the control boards of any two adjacent ring plates 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 Publication No. 2009-531553 discloses wireless communication between the sensor and the actuator. However, in the spinning machine, such as a ring spinning machine having a plurality of spinning stations and a yarn detecting device generating electrical signals to an actuator by

wireless communication, there is a fear that malfunction of the spinning machine is caused by a noise due to the wireless communication.

[0006] The present invention which has been made in light of the above problems is directed to providing a yarn detecting system for a spinning machine which makes it unnecessary to remove signal cables between yarn detecting units in removing the ring plates and in which the malfunction due to a noise hardly occurs.

SUMMARY OF THE INVENTION

[0007] In accordance with the present invention, a yarn detecting system for a spinning machine includes a plurality of yarn detecting units, a signal transmitter and a signal receiver. The spinning machine includes a plurality of spinning stations, a base, a plurality of ring plates mounted to the base and a main controller. Each ring plate is provided for a plurality of the spinning stations. Each yarn detecting unit is provided for each ring plate and includes a plurality of yarn detecting devices which is provided for the respective spinning stations and each of which includes a sensor and generates a detection signal indicative of a state of yarn at the spinning station and a determining device which determines the state of the yarns according to the detection signals and generating first pulse signals representing the state of the yarns. The signal transmitter and the signal receiver are provided between the adjacent ring plates. Signal transmission is performed from the determining device to the main controller and the signal transmission between the signal transmitter and the signal receiver is performed in a non-contact manner.

[0008] 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

[0009] 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 fragmentary plan view of a ring spinning machine showing ring plates and a yarn detecting system according to a preferred embodiment of the present invention;

Fig. 1B is a circuit diagram showing a configuration for signal transmission between two adjacent yarn detecting units of the yarn detecting system of Fig. 1A disposed on the ring plates;

Fig. 2 is a schematic cross-sectional side view showing a ring of the ring spinning machine and a sensor

of the yarn detecting system of Fig. 1A;

Fig. 3 is a schematic cross-sectional side view showing a support member of the yarn detecting system of Fig. 1A;

Fig. 4 is a circuit diagram showing a differential driver of the yarn detecting system of Fig. 1A; and

Fig. 5 is a timing chart showing pulse signals generated in the yarn detecting system of Fig. 1A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0010] The following will describe a yarn detecting system for a ring spinning machine according to a preferred embodiment of the present invention with reference to Figs. 1 through 5. The ring spinning machine has a plurality of ring plates 11 that are arranged in two rows on the both sides of the base. For the sake of ease of assembling, the spinning machine is so configured that one ring plate 11 includes twenty-four spinning stations. For example, in a ring spinning machine having four hundreds eighty spinning stations, two rows of ring plates 11 each having ten ring plates 11 are arranged one behind the other. When the ring spinning machine has nine hundreds sixty spinning stations, twenty ring plates 11 are arranged in each row.

[0011] As shown in Fig. 1A, each ring plate 11 has a plurality of rings 12 which are arranged in 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.

[0012] 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 spinning stations and a CPU 15 (shown in Fig. 3). The CPU 15 serves as a determining device. The yarn detecting device 14 has a sensor 14A detecting the state of a yarn at each spinning station and generating a detection signal indicative of a state of a yarn. The CPU 15 determines the state of yarns according to the detection signals from the sensors 14A. Specifically, the detection 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 breakage) at the twenty-four spinning stations. The CPU 15 is mounted 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. As shown in Figs. 2 and 3, the ring plate 11 has a front wall 11A and a hole 11B formed therethrough. A support member 18 is fixed to the front wall 11A of the ring plate 11 and extends 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.

[0013] 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 adapted to detect 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 enclosing therein the sensor 14A and a fixing member 20 which is inserted through the hole 11B formed through the ring plate 11. The cover 19B is made of a non-magnetic material such as a stainless steel or a resin. The yarn detecting device 14 of the present invention has a structure that is similar to the yarn detecting device of the Publication No. 2010-111982. The mounting plate 19A is fixed to the ring plate 11 by the fixing member 20 which 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.

[0014] Though not shown in the drawings, 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 of the sensor 14A. The pickup coil detects the movement of the traveler 13 by the electromagnetic induction generated by the movement of the traveler 13 traveling the magnetic circuit.

[0015] The control board 17 has a printed circuit (not shown) for transmitting to the CPU 15 detection signals generated by the sensor 14A of the yarn detecting device 14. The printed circuit is electrically connected to a flexible cable 22 having a connector 22A that is connectable to the connector 21A. Thus, the detection 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 processing result of the detection signal of the yarn detecting device 14 by the CPU 15. The signal transmission is performed from the CPU 15 to the main control device 23 and the signal transmission between the signal transmitter 31 and the signal receiver 32 provided between the adjacent ring plates 11 is performed in a non-contact manner or by wireless communication.

The main control device 23 is configured to control the operation of the entire ring spinning machine, as well as to receive detection signals from the CPU 15 of the yarn detecting unit 16. 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, to receive data representing the state of yarn at each spinning station from the CPUs 15 of the respective yarn detecting units 16 and to control the respective drive units so as to control the operation of the ring spinning machine according to the desired spinning conditions.

[0017] As shown in Fig. 1B, the ring plate 11 is provided with a signal transmitter 31 transmitting a signal indicative of the state of yarn and a signal receiver 32 receiving the signal from the signal transmitter 31. Transmitting and receiving of the signal between the signal transmitter 31 and the signal receiver 32 provided between any two adjacent ring plates 11 is performed in a non-contact manner or by wireless communication. It is noted that the ring plate 11 located furthest from the main control device 23 has only the signal transmitter 31.

[0018] The signal transmitter 31 includes a differential driver 33 and a transmitting coil 34. The signal transmitter 31 converts original pulse signals from a controller 35 and transmits the converted pulse signals to the signal receiver 32. The original pulse signal serves as a first pulse signal and the converted pulse signal serves as a second pulse signal. The signal receiver 32 includes a receiving coil 36, a receiver circuit 37 and a set-reset latch circuit (SR latch circuit) 38. The signal receiver 32 receives the converted pulse signals from the signal transmitter 31, decodes the received converted pulse signals into the original pulse signals and outputs the original pulse signals to the controller 35.

[0019] The transmitting coil 34 is disposed on the ring plate 11 on the side adjacent to the main control device 23 and the receiving coil 36 is disposed on the ring plate 11 on the opposite side thereof. In this preferred embodiment, the transmitting coil 34 is disposed on the right end of the ring plate 11 and the receiving coil 36 is disposed on the left end of the ring plate 11 as viewed in Fig. 1B.

[0020] The controller 35 disposed on the ring plate 11 transmits the signals representing the state of yarns which has been sent for the main control device 23 by the controller 35 disposed on the next ring plate 11 far from the main control device 23, as well as the signals representing the state of yarns and generated by the yarn detecting devices 14 disposed on the ring plate 11 on which the above controller 35 is disposed. The controller 35 disposed on the ring plate 11 closer to the main control device 23 transmits more data through the signal transmitter 31. According to the preferred embodiment, the controller 35 forms a part of the CPU 15.

[0021] The following will describe the differential driver 33 in detail. The differential driver 33 has an input terminal 33IN, an enable terminal 33EN and output terminals

33OUT and the transmitting coil 34 is connected to the output terminals 33OUT. The original pulse signal generated by the controller 35 is input to the input terminal 33IN of the differential driver 33 and the pulse signal generated by the controller 35 to form the predetermined pulse train is input to the enable terminal 33EN. When the pulse signal of the predetermined pulse train input to the enable terminal 33EN is at high level (1), positive or negative current flows in the transmitting coil 34 which is connected to the output terminals 33OUT.

[0022] More specifically, the differential driver 33 includes a first transistor TR1 of PNP transistor, a second transistor TR2 of PNP transistor, a third transistor TR3 of PNP transistor, a fourth transistor TR4 of NPN transistor and a fifth transistor TR5 of NPN transistor. The first transistor TR1 is connected at the emitter thereof to a power supply VCC, at the base thereof to the enable terminal 33EN and at the collector thereof to the emitters of the second and the third transistors TR2, TR3. The second transistor TR2 is connected at the collector thereof to the collector of the fourth transistor TR4 and the output terminal 33OUT. The third transistor TR3 is connected at the collector thereof to the collector of the fifth transistor TR5 and the output terminal 33OUT. The fourth and the fifth transistors TR4, TR5 are connected at the emitters thereof to a ground GND, respectively. The second and the fourth transistors TR2, TR4 are connected at the bases thereof to the input terminal 33IN through NOT gates, respectively. The third and the fifth transistors TR3, TR5 are directly connected at the bases thereof to the input terminal 33IN, respectively.

[0023] The following will describe the receiver circuit 37 in detail. The SR latch circuit 38 has set and reset ports S, R. The receiver circuit 37 outputs a pulse signal at low level (0) to the set and the reset ports S, R of the SR latch circuit 38 while no current flows in the receiving coil 36. The receiver circuit 37 outputs a pulse signal at high level (1) to the set port S of the SR latch circuit 38 and a pulse signal at low level (0) to the reset port R of the SR latch circuit 38 based on pulsed current flowing in the receiving coil 36 during the rise time of the original pulse signal. The receiver circuit 37 outputs a signal at high level (1) to the reset port R of the SR latch circuit 38 and a signal at low level (0) to the set port S of the SR latch circuit 38 based on pulsed current flowing in the receiving coil 36 during fall time of the original pulse signal.

[0024] The following will describe the operation of the yarn break detecting system thus constructed. Due to the magnetizing effect of the permanent magnet of the sensor 14A, 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. During normal spinning operation at a spinning station of the ring spinning machine when a cop (not shown) is rotated without a yarn break, the traveler 13 travels sliding on the ring flange 12A at a speed corresponding to the

rotational speed of the cop. Each time the traveler 13 makes one rotation on the ring flange 12A and the traveler 13 passes through the magnetic circuit, pulsed voltage is generated across the pickup coil of the sensor 14A synchronously with the rotation of the traveler 13. When a yarn break occurs, the generation of the pulsed voltage across the pickup coil synchronously with the rotation of the traveler 13 is interrupted.

[0025] Responding to the signals generated by twenty-four sensors 14A provided on each ring plate 11 to the CPU 15 of the ring plate 11, the CPU 15 determines that the state of yarn is normal when the pulsed voltage is output and that a yarn break is present when there is no output of pulsed voltage. Pulse signals representing the presence or absence of yarn break at any of the spinning stations and the position (or the number) of the spinning stations having a yarn break are sent to the main control device 23 at a regular time interval by the CPUs 15 provided on the respective control boards 17 through the controllers 35, the signal transmitters 31 and the signal receivers 32 of the respective ring plates 11. The main control device 23 determines the spinning conditions of the spinning stations based on the pulse signals sent by the respective CPUs 15.

[0026] More specifically, the pulse signals sent by the CPUs 15 disposed on the respective ring plates 11 other than that located closest to the main control device 23 are sent to the CPU 15 provided on the ring plate 11 located closest to the main control device 23 through the signal receivers 32, the controllers 35 and the signal transmitters 31 provided on the ring plates 11 other than that located closest to the main control device 23. The pulse signals detected by the yarn detecting device 14 of the ring plate 11 located closest to the main control device 23 and the pulse signals detected by the yarn detecting devices 14 of the rest of the ring plates 11 are sent to the main control device 23 by the CPU 15 provided on the ring plate 11 located closest to the main control device 23 by wired or wireless communication.

[0027] The pulse signal generated by the CPU 15 to the controller 35 is a pulse signal having a large width, as shown by the original pulse signal in Fig. 5. The controller 35 outputs signals to the input terminal 33IN of the differential driver 33. The controller 35 has a function of converting the original pulse signals having a relatively large pulse width into one-shot pulse signals having an extremely small pulse width and occurring at times corresponding to the rise time and the fall time of the original signals. The converted one-shot pulse signals are output to the enable terminal 33EN of the differential driver 33.

[0028] In the differential driver 33, the transistors shown in Fig. 4 are operated based on the signals from the input terminal 33IN and the enable terminal 33EN. As shown in Fig. 5, in the state that the original pulse signal at high level (1) is applied to the input terminal 33IN, the second and the fifth transistors TR2, TR5 are turned ON and the third and the fourth transistors TR3, TR4 are turned OFF. During the time other than the

above, the first transistor TR1 is maintained OFF and no current flows in the transmitting coil 34, because a pulse signal is applied to the enable terminal 33EN only at times corresponding to the rise and fall times of the original pulse signal.

[0029] At the fall time of original pulse signal, the third and the fourth transistors TR3, TR4 are turned ON and the second and the fifth transistors TR2, TR5 are turned OFF. When a pulse signal is input to the enable terminal 33EN, the first transistor TR1 is turned ON. As a result, current from the power source VCC flows through the first transistor TR1, the third transistor TR3, the transmitting coil 34, the fourth transistor TR4 and the ground GND in this order. Thus, the current flows through the transmitting coil 34 upward as seen in Fig. 4. In this preferred embodiment, the current flowing upward is negative. Accordingly, a current of negative charge flows through the transmitting coil.

[0030] During the rise time of the original pulse signal, the second and the fifth transistors TR2, TR5 are turned ON and the third and the fourth transistors TR3, TR4 are turned OFF. When a pulse signal is input to the enable terminal 33EN, the first transistor TR1 is turned ON. As a result, current from the power source VCC flows through the first transistor TR1, the second transistor TR2, the transmitting coil 34, the fifth transistor TR5 and the ground GND in this order. Thus, a current flows through the transmitting coil 34 downward as seen in Fig. 4. Thus, a current of positive charge flows through the transmitting coil 34.

[0031] While the pulsed current flows through the transmitting coil 34, a current flows through the receiving coil 36 due to the electromagnetic induction. As a result, a pulsed current flows through the transmitting coil 34 during the rise and fall time of the original pulse signal and a pulsed current flows through the receiving coil 36 due to the electromagnetic induction, as shown in Fig. 5.

[0032] In this preferred embodiment, the pulsed current flows through the receiving coil 36 for an extremely short time in response to the pulsed current flowing through the transmitting coil 34 when the original pulse signal is turned to high level or low level. The direction of the current flowing in the receiving coil 36 is opposite during the rise and fall times of the original signal. The receiver circuit 37 is connected to the receiving coil 36. When the pulsed current flows through the receiving coil 36 during the rise time of the original signal, the receiver circuit 37 outputs a set signal to the set port S of the SR latch circuit 38. When pulsed current flows through the receiving coil 36 during the fall time of the original signal, the receiver circuit 37 outputs a reset signal to the reset port R of the SR latch circuit 38. The output signal from a port Q of the SR latch circuit 38 is turned high level (1) during the rise time of the original signal and maintained at high level (1) until the fall of original signal occurs. Then, the output signal from a port Q of the SR latch circuit 38 is turned to low level (0) during fall time of the original pulse signal and maintained at low level (0) until

the rise of original pulse signal occurs. Thus, the output signal from the port Q of the SR latch circuit 38 is decoded into the original pulse signal based on the current flowing through the receiving coil 36.

[0033] For example, a pulse transformer using the electromagnetic induction may be used for signal transmission. In the case that signal transmission is performed by the pulse transformer in a non-contact manner between coils provided on any two adjacent ring plates 11 and facing each other, the coils do not have an inductance that is high enough for the desired transmission characteristics of the pulse width due to a gap formed between the coils. For obtaining the desired inductance, the size of the coils or the signal frequency may be increased, but the size of the coils is difficult to be increased due to the restriction of the size of the system. Increasing the signal frequency and the restrictions for parts used in the system, so that the cost of the system is increased for ensuring the reliability of the signal transmission.

[0034] According to this preferred embodiment, the transmitting coil 34 of the signal transmitter 31 does not transmit the original signals having a wide pulse width and representing the state of a yarn as it is, but the original pulse signals are converted into a pulse train having high frequency pulses each having an extremely short pulse width each corresponding to rise time or the fall time of the original pulse signal, as shown in Fig. 5. Therefore, pulse signal representing the state of a yarn may be transmitted without increasing the size of the coils or the signal frequency.

[0035] This preferred embodiment of the present invention offers the following advantageous effects.

(1) The yarn detecting system includes the yarn detecting units 16 provided for the respective ring plates 11 and each having the yarn detecting device 14 which is provided for each spinning station and the CPU 15 serving as the determining device determining the state of a yarn at each spinning station based on a detection signal from the yarn detecting device 14. The transmission of the signal from the CPU 15 to the main control device 23 is performed in a non-contact manner or by wireless communication between the signal transmitter 31 and the signal receiver 32 provided on any two adjacent ring plates 11.

No signal wiring is required for connection between the yarn detecting units 16 of the adjacent ring plates 11. Therefore, troublesome removals of any signal wiring and any connector between any two adjacent yarn detecting units 16 during removal of any ring plates 11 are not needed, thus the manufacturing cost of the yarn detecting system being reduced. There are no possibility in the yarn detecting system in which damages or breaks are caused by degradation due to connecting and removing of the signal wiring between the ring plates 11. The distance between the signal transmitter 31 and the signal receiver

32 is short enough to prevent malfunction of the yarn detecting unit 16 due to noise produced between the signal transmitter 31 and the signal receiver 32.

(2) The signal transmitter 31 includes the transmitting coil 34 and the signal receiver 32 includes the receiving coil 36. Signal transmission between the signal transmitter 31 and the signal receiver 32 is performed by the electromagnetic induction between the transmitting coil 34 and the receiving coil 36. As a method to perform the signal transmission between the signal transmitter 31 and the signal receiver 32 in a non-contact manner, electromagnetic induction, static induction or light induction may be used. The method using the static induction or the light induction tends to be easily affected by collection of cotton fly. In contrast to the static induction or the light induction method, the method using the electromagnetic induction may prevent reduction of performance of the signal transmission due to the collection of cotton fly to the transmission parts of the yarn detecting system.

(3) The signal transmitter 31 converts the original pulse signals into pulse signals having an extremely short pulse width and corresponding to the raise time and the fall time of the original signals and allows a current to flow in the transmitting coil 34 based on the converted pulse signal. The signal receiver 32 decodes the pulse signal received by the receiving coil 36.

According to the preferred embodiment, the original pulse signal having a large pulse width is converted by the signal transmitter 31 into pulse signal having an extremely short pulse width and applies current to the transmitting coil 34 based on the converted pulse signal. The signal receiver 32 decodes the pulse signal received by the receiving coil 36 into the original pulse signal. Thus, signal transmission between the transmitting coil 34 and the receiving coil 36 is performed effectively without increasing the size of the transmitting coil 34 and the receiving coil 36 or increasing the frequency of the original pulse signal. Therefore, the yarn detecting system according to this preferred embodiment is easy to be installed and less costly. Additionally, the time during which current flows in the transmitting coil 34 is relatively short, so that power consumption of the yarn detecting system is reduced.

(4) The signal transmitter 31 includes the differential driver 33. The original pulse signal is input to the input terminal 33IN of the differential driver 33 and high frequency pulse signal having an extremely short pulse width is input to the enable terminal 33EN of the differential driver 33 during the rise time and the fall time of the original pulse signal. Pulse signal

having the same pulse width as the high frequency pulse signal is output to the transmitting coil 34. Consequently, a current flows in the transmitting coil 34 for an extremely short time in one direction during the rise time of the original pulse signal and in opposite direction during the fall time of the original pulse signal. Pulse signal transmission is performed effectively between the transmitting coil 34 and the receiving coil 36 without increasing the size of the transmitting coil 34 and the receiving coil 36 or the frequency of the original pulse signal.

(5) The signal receiver 32 includes the receiver circuit 37 and the SR latch circuit 38. The receiver circuit 37 is connected to the receiving coil 36. The receiver circuit 37 outputs a set signal to the set port S of the SR latch circuit 38 when pulsed current flows in the receiving coil 36 during the rise of the original signal and a reset signal to the reset port R of the SR latch circuit 38 when pulsed current flows in the receiving coil 36 during the fall time of the original signal. Thus, decoding into the original pulse signal may be performed based on the current flowing through the receiving coil 36.

[0036] According to the present invention, the above embodiment may be modified in various ways as exemplified below.

[0037] The present invention is not limited to the structure in which electromagnetic induction is performed in a non-contact manner between the transmitting coil 34 and the receiving coil 36, but signal transmission from the CPU 15 as the determining device to the main control device 23 may be performed in a non-contact manner between the signal transmitter 31 and the signal receiver 32 disposed between any two adjacent ring plates 11. Light induction, static induction or general wireless communication may be used for the signal transmission.

[0038] The transistors of the differential driver 33 are not limited to a bipolar transistor, but may be a metal oxide semiconductor field-effect transistor (MOSFET).

[0039] The latch circuit of the signal receiver 32 for decoding is not limited to the SR latch circuit 38, but may be a latch circuit of any other type.

[0040] The yarn detecting system is not limited to the type which determines only the presence or absence of a yarn break based on the detection signal of the yarn detecting device 14, but may be of a type which determines whether or not the yarn is loose twisted. For determining whether or not the yarn is loose twisted at a spinning station, rotational speed of the traveler 13 per unit of time may be calculated by counting the number of the pulses generated by the yarn detecting device 14 according to the rotational speed of the traveler 13 per unit of time. The number of twists of a yarn at the spinning station is calculated based on the above rotational speed and the spinning speed of the spinning machine, and the determination of a loose twist of yarn may be made by

comparing the calculated number of twists with any predetermined number of twists.

[0041] The yarn detecting device 14 may be modified so as to be operable without power supply from an external source by resin molding the sensor 14A with a magnetic yoke made of a magnetic material and a pickup coil wound around the magnetic yoke and using a disk shaped permanent magnet for the traveler 13. In such modified yarn detecting device 14, the CPU 15 determines the presence or absence of a yarn break and also of a loose twist of a yarn based on variation of the detection signals occurring due to electromagnetic induction which is caused by variation of the distances between the pickup coil and the traveler 13 traveling on the ring flange 12A.

[0042] The yarn detecting device 14 may be of a type that needs to use power supply, such as a transmit/receive type photo sensor or a static induction type sensor.

[0043] In the embodiment, the CPU 15 forms a part of the controller 35. Alternatively, the controller 35 and the CPU 15 may be provided separately.

[0044] According to the present invention, the yarn detecting device 14 does not necessarily need to be provided for each ring 12, but may have the sensor 14A provided for each spinning station. One yarn detecting device having two sensors 14A may be provided for two rings 12 or one yarn detecting device having three sensors 14A may be provided for three or more rings 12.

[0045] The control board 17 may be mounted directly to the front wall 11A of the ring plate 11 by means of a bolt or a screw inserted through a hole formed through the front wall 11A.

[0046] The number of the rings 12 provided for each ring plate 11 is not limited to be twenty-four, but may be more or less than twenty-four.

[0047] In the embodiment, detection signals generated by the sensors 14A of the yarn detecting devices 14 provided for each ring plate 11 are processed by one CPU 15. Alternatively, such detection signals may be processed by a plurality of CPUs 15 provided for a plurality of the control boards 17.

[0048] The CPU 15 correspond to each yarn detecting device 14 does not need to be configured to determine the state of a yarn, but is configured only to receive and transmit pulse signals representing the state of yarn and an additional control device or a device incorporated in the main control device 23 may receive the pulse signals sent from the CPU 15 and determine the state of yarn, such as yarn break.

[0049] The yarn detecting device 14 does not need to have a protection structure including the mounting plate 19A and the cover 19B for protecting the mounting plate 19A and the sensor 14A, but may include a structure formed integrally with the sensor 14A and the mounting plate 19A without the cover 19B.

[0050] The ring plate 11 is not limited to a structure having a reverse U-shaped cross-section, but the ring plate 11 may have a crank-shaped cross-section and the

yarn detecting device 14 may be mounted to the rear wall of the ring plate 11, Power transmission to the CPU 15 and the controller 35 provided on each ring plate 11 may be performed in a non-contact manner or by wire. When the power transmission is performed by wire, the power wire and its connector used for the transmission need to be removed and separated, respectively, when removing the ring plate 11. When the power transmission is performed in a non-contact manner, the signal wire, the power wire and its connector do not need to be removed when removing the ring plate 11.

[0051] The present invention is not limited to an application to the ring spinning machine, but it may be applied to any spinning machines having a plurality of ring plates such as 11 on the base. For example, the present invention may be applied to a ring twisting machine.

[0052] A yarn detecting system for a spinning machine includes a plurality of yarn detecting units, a signal transmitter and a signal receiver. Each ring plate is provided for a plurality of spinning stations. The yarn detecting unit is provided for each ring plate and includes a plurality of yarn detecting devices which is provided for the respective spinning stations and each of which includes a sensor and generates a detection signal indicative of a state of yarn at the spinning station and a determining device which determines the state of the yarns according to the detection signals and generates first pulse signals representing the state of the yarns. Signal transmission is performed from the determining device to the main controller and the signal transmission between the signal transmitter and the signal receiver provided between the adjacent ring plates is performed in a non-contact

Claims

1. A yarn detecting system for a spinning machine, the spinning machine including a plurality of spinning stations, a base, a plurality of ring plates (11) mounted to the base and a main controller (23), each ring plate provided for a plurality of the spinning stations, the yarn detecting system **characterized in that** the yarn detecting system includes:

a plurality of yarn detecting units (16) each provided for each ring plate (11), each yarn detecting unit (16) including:

a plurality of yarn detecting devices (14) provided for the respective spinning stations, each yarn detecting device (14) including a sensor (14A) and generating a detection signal indicative of a state of yarn at the spinning station; and

a determining device (15) determining the state of the yarns according to the detection signals and generating first pulse signals representing the state of the yarns; and

a signal transmitter (31) and a signal receiver (32) provided between the adjacent ring plates (11),

in that signal transmission is performed from the determining device (15) to the main controller (23) and the signal transmission between the signal transmitter (31) and the signal receiver (32) is performed in a non-contact manner.

2. The yarn detecting system according to claim 1, **characterized in that** the signal transmitter (31) includes a transmitting coil (34), the signal receiver (32) includes a receiving coil (36), the signal transmission between the signal transmitter (31) and the signal receiver (32) is performed by electromagnetic induction between the transmitting coil (34) and the receiving coil (36).
3. The yarn detecting system according to claim 2, **characterized in that** the signal transmitter (31) converts the first pulse signals into second pulse signals having extremely short pulse width corresponding to a rise time of the first pulse signal and a fall time of the first pulse signal, the signal transmitter (31) allows a current to flow in the transmitting coil (34) based on the second pulse signals and the signal receiver (32) decodes the second pulse signals received by the receiving coil (36) into the first pulse signals.
4. The yarn detecting system according to claim 3, **characterized in that** the current flows in the transmitting coil (34) in one direction during the rise time of the first pulse signal and the current flows in the transmitting coil (34) in opposite direction during the fall time of the first pulse signal.
5. The yarn detecting system according to claim 4, **characterized in that** the signal transmitter (31) includes a differential driver (33) connected to the transmitting coil (34).
6. The yarn detecting system according to claim 3, **characterized in that** the signal receiver (32) includes a receiver circuit (37) connected to the receiving coil (36) and a latch circuit (38) connected to the receiver circuit (37), **in that** the second pulse signal is decoded into the first pulse signal by the receiver circuit (37) and the latch circuit (38).

FIG. 1A

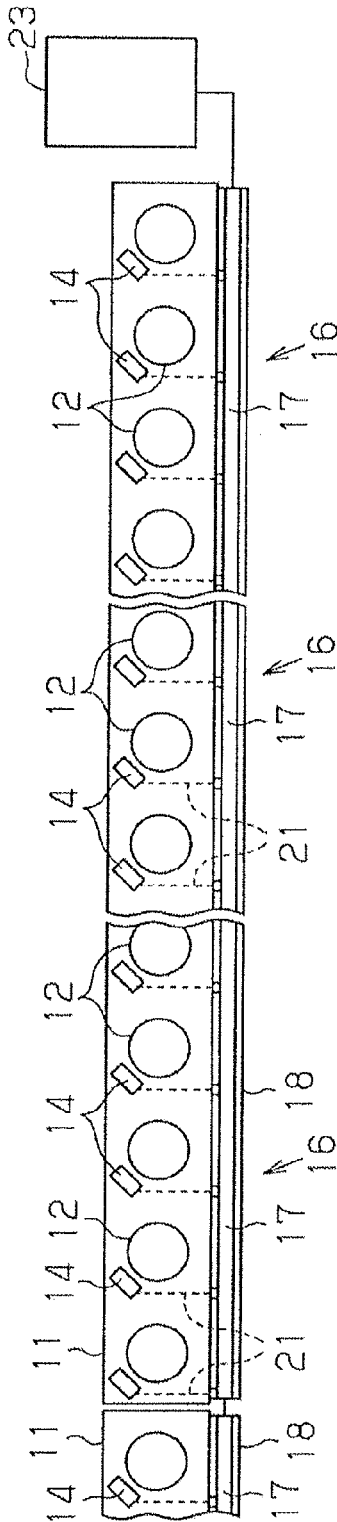


FIG. 1B

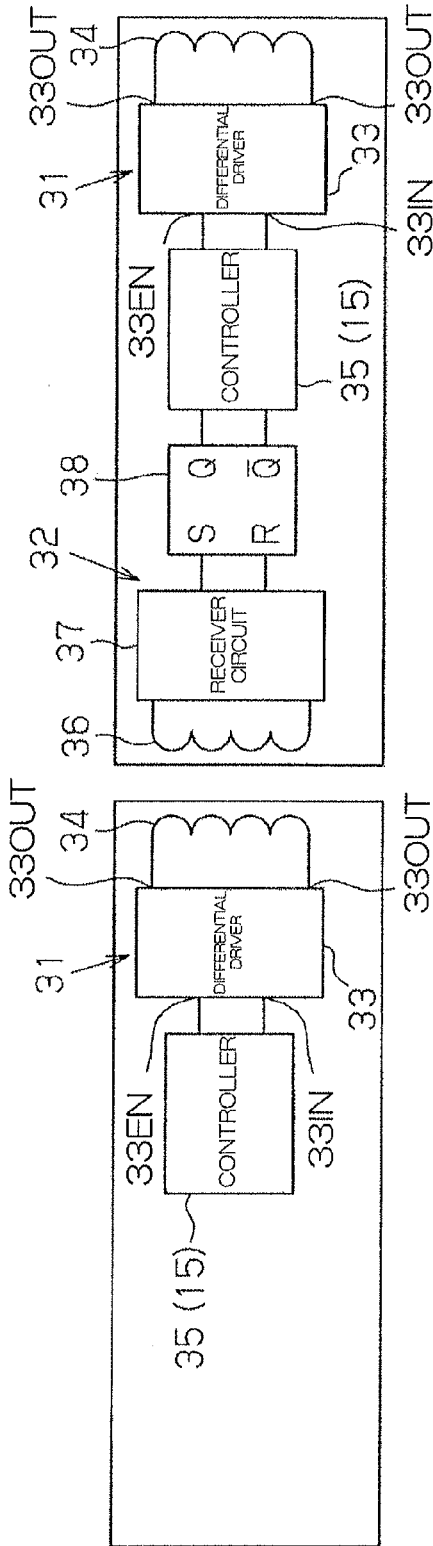


FIG. 2

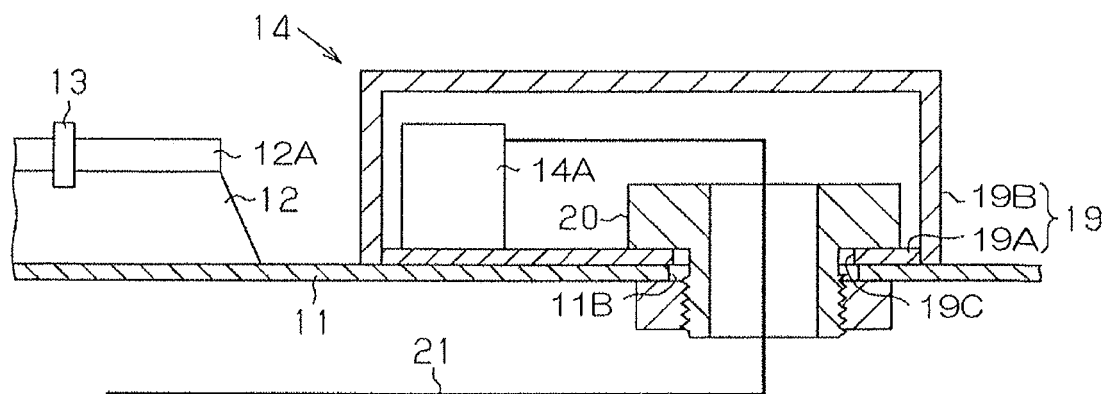


FIG. 3

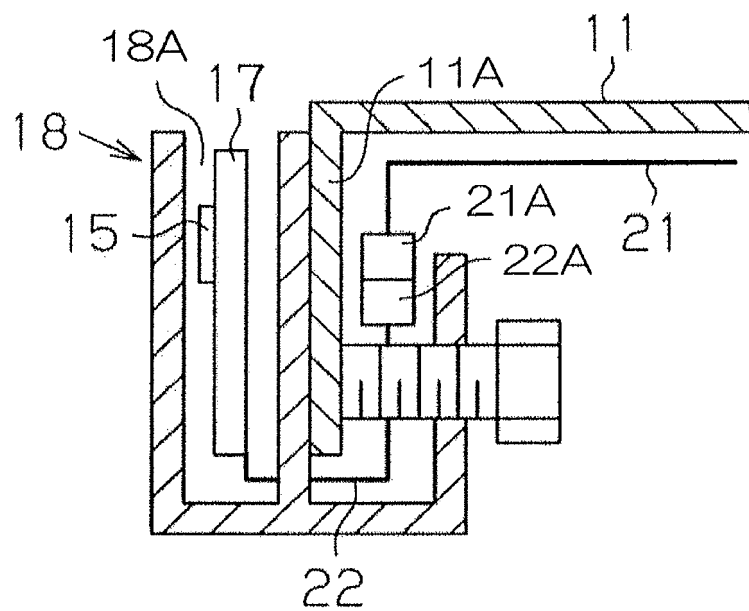


FIG. 4

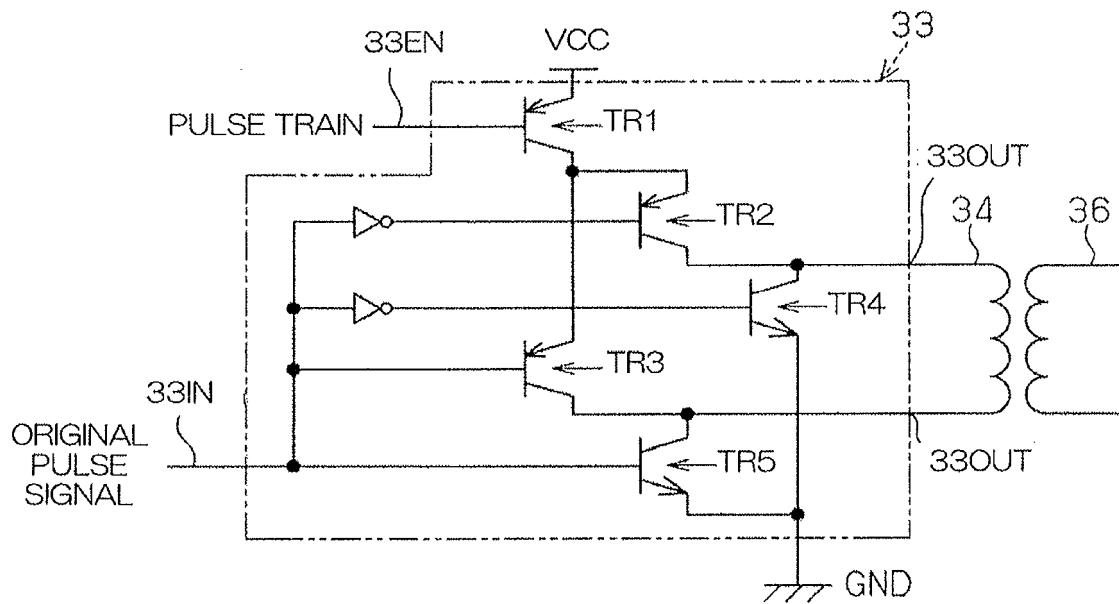
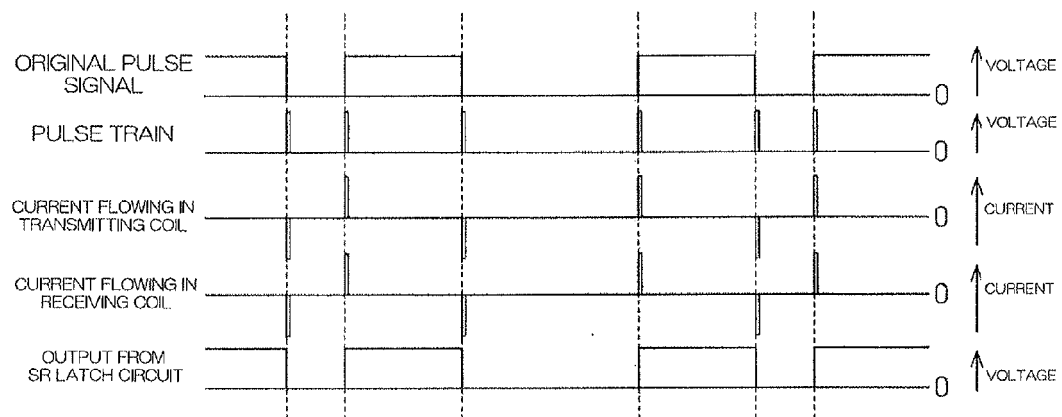


FIG. 5



REFERENCES CITED IN THE DESCRIPTION

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