The present invention allows a yarn splicing carriage to efficiently remove a yarn defect and perform a yarn splicing operation without a waste of a yarn, in accordance with the situation in which the yarn defect has occurred. A textile machine comprises a plurality of yarn processing units 2 and a yarn splicing carriage 3 that can run in the direction in which the yarn processing units 2 are arranged. Each of the yarn processing units 2 comprises a yarn clearer 52 that can detect a yarn defect and determine its type. The yarn splicing carriage 3 can acquire information on the presence or absence and type of a yarn defect and the diameter of a winding package 45 for each yarn processing unit 2. The yarn splicing carriage 3 performs a yarn end finding operation on the yarn processing unit 2 in which a yarn defect is occurring. In this case, depending on the type of the detected yarn defect and the diameter of the winding package 45 measured upon the occurrence of the yarn defect, the yarn splicing carriage 3 varies the amount of time from when a suction mouth 46 approaches to the winding package 45 and then starts suction until when the suction mouth 46 guides a yarn to a splicing device 43 as well as the speed of a reverse rotation roller 55 that rotates the winding package 45 in a yarn unwinding direction. Subsequently, the yarn splicing device 43 removes the yarn defect and splices the spun yarn (Fig. 2).
Description

Field of the Invention

[0001] The present invention relates to a textile machine comprising a yarn defect detector.

Background of the Invention

[0002] The Unexamined Japanese Patent Application Publication (Tokkai-Hei) No. 10-310330 discloses an automatic winder (one example of textile machines) in which a plurality of winding units are arranged in a line. In the automatic winder, each of the winding units comprises a yarn clearer as a yarn defect detecting means. The yarn clearer can output detection signals for the plural types of yarn defects determined depending on the thickness and length of the yarn defect. Then, a yarn defect removal length for a yarn defect removing process can be varied depending on the length of the detected yarn defect.

[0003] For example, the Unexamined Japanese Patent Application Publication (Tokkai-Hei) No. 2001-40532 discloses an apparatus that can run along a plurality of yarn processing units arranged in a line to perform a yarn splicing operation in response to a yarn splicing request from any of the yarn processing units. However, none of such apparatuses can change the yarn defect removing process depending on the length of the detected defect as in the case of The Unexamined Japanese Patent Application Publication (Tokkai-Hei) No. 10-310330.

Summary of the Invention

[0004] A description has been given of the problems to be solved by the invention, and now, a description will be given of means for solving the problems and its effects.

[0005] An aspect of the present invention provides a textile machine configured as described below. A textile machine comprises a plurality of yarn processing units arranged in a line, a yarn splicing carriage and a control device for the yarn splicing carriage. The yarn splicing carriage can run along a direction in which the yarn processing units are arranged. In addition, the yarn splicing carriage performs a yarn splicing operation in accordance with a yarn splicing request from the yarn processing units. Each of the yarn processing units comprises a winding section which winds a yarn into a winding package, a yarn defect detector which detects a defect in a yarn traveling to the winding section and which can determine the type of the yarn defect, and discontinuing means for discontinuing the winding yarn in accordance with detection of the yarn defect carried out by the yarn defect detector. The yarn splicing carriage comprises yarn end finding means for finding a yarn end from the winding package in which the yarn has been discontinuously by the discontinuing means, yarn defect removing means for removing the yarn defect from the found yarn end, and a yarn splicing device which performs a yarn splicing operation. The control device for the yarn splicing carriage acquires, for each yarn processing unit, information on the presence or absence of a yarn defect and information on a yarn processing status observed upon occurrence of the yarn defect. When the yarn splicing carriage removes a yarn defect from a yarn processing unit in which the yarn defect has occurred and performs a yarn splicing operation on the yarn processing unit, the control device controls the yarn end finding means of the yarn splicing carriage in accordance with the acquired information on the yarn processing status observed upon occurrence of the yarn defect.

[0006] Thus, the control device in the yarn splicing carriage can control the yarn end finding means of the yarn splicing carriage using the status of the yarn processing executed on the recognized yarn defect. Consequently, the yarn splicing carriage can remove the yarn defect and perform a yarn splicing operation in a short time without wasting the yarn. Moreover, the control device for the yarn splicing carriage can collectively manage the information on the occurrence of a yarn defect and the yarn processing status observed upon occurrence of the yarn defect, for all the yarn processing units in association with identification information on each yarn processing unit. It is thus possible to easily determine which of the plurality of yarn processing units is to be subjected to removal of a yarn defect and a yarn splicing operation by the yarn splicing carriage. In other words, an operation target unit can be determined easily.

[0007] The textile machine is preferably configured as described below. The yarn end finding means includes catching and guiding means which approaches to a surface of the winding package to catch the yarn end and guide the yarn end to the yarn splicing device. The control of the yarn end finding means includes controlling a yarn end catching time of the catching and guiding means in accordance with the information on the yarn processing status observed upon occurrence of the yarn defect.

[0008] This enables the entire yarn defect to be reliably caught by the catching and guiding means and then removed by the yarn defect removing means. Further, in case of a short defect, the yarn end catching time is controlled to be short. This makes it possible to reduce the time required to remove the yarn defect.

[0009] The textile machine is preferably configured as described below. The yarn splicing carriage is provided with detecting means for detecting the yarn caught by the catching and guiding means. The yarn end catching time of the catching and guiding means is controlled in accordance with detection of the yarn carried out by the detecting means.

[0010] This allows the control of the amount of time from when the detecting means confirms that the yarn has been caught (that is, confirms that the yarn end has been successfully found) until when the process shifts to a yarn splicing operation. Consequently, the entire yarn defect can be further reliably caught by the catching and guiding means. This prevents, for example, the following...
situation: the process shifts to a yarn splicing operation before a long defect has not entirely been led out, so that the yarn defect removing means can only partly remove the long defect, with the remaining part of the yarn defect wound around the winding package.

[0011] The textile machine is preferably configured as described below. The control device for the yarn splicing carriage is configured to acquire information on the diameter of the winding package for each yarn processing unit, the information on the diameter of the winding package constituting the information on the yarn processing status observed upon occurrence of the yarn defect. The yarn end finding means includes reverse rotation means for rotating the winding package in a direction in which the yarn is unwound. The control of the yarn end finding means includes controlling the speed of the reverse rotation means on the diameter of the winding package.

[0012] Thus, the rotation speed of the reverse rotation means is varied depending on the diameter of the winding package. This makes it possible to increase the success rate of a yarn end finding operation and to reduce the time required for the yarn end finding operation.

[0013] In the textile machine, control is preferably performed such that as the diameter of the winding package observed upon the occurrence of the yarn defect is large, a reverse rotation speed of the reverse rotation means is increased.

[0014] Thus, the winding package is reversely rotated at a low speed when having a small diameter. This prevents the end of the unwound yarn from being swung at a high speed and prevents the failure of the yarn end catching by the yarn end finding means. Further, the winding package is reversely rotated at a high speed when having a large diameter. This makes it possible to reduce the time required for a yarn end finding operation.

[0015] The textile machine is preferably configured as described below. Each of the yarn processing units comprises a storage section. When the yarn defect detector detects a yarn defect, the storage section stores the information on the presence of the yarn defect and the yarn processing status observed upon the occurrence of the yarn defect and outputs the stored information to the control device for the yarn splicing carriage. Once the yarn splicing carriage completes removing the yarn defect from the yarn processing unit with the yarn defect and performing a yarn splicing operation on the yarn processing unit, the information stored in the storage section of the yarn processing unit is reset. The expression "the information is reset" means deletion of information on the presence of a yarn defect and deletion of information on the yarn processing status observed upon the occurrence of the yarn defect.

[0016] Thus, if the yarn splicing operation and the yarn defect removing operation fail, the control device for the yarn splicing carriage performs control such that the yarn processing unit continuously outputs the above information. This makes it possible to recognize that the operations have not been completed and that the winding operation can not be resumed.

[0017] The textile machine is preferably configured as described below. The yarn splicing carriage comprises display means. When the yarn splicing carriage is located at the yarn processing unit in which a yarn defect is occurring, the display means can display the type of the yarn defect in the yarn processing unit.

[0018] Thus, by viewing the display means of the yarn splicing carriage, an operator can easily understand the type of a yarn defect occurring in the yarn processing unit.

Brief Description of the Drawings

[0019] Figure 1 is a front view showing the entire configuration of a spinning device in accordance with an embodiment of the present invention.

Figure 2 is a vertical side view of the spinning device in accordance with the embodiment of the present invention.

Figure 3 is a block diagram of the spinning device.

Figure 4 is a flowchart showing control performed by a unit controller for a spinning unit.

Figure 5 is a flowchart showing control performed by a carriage control device for a yarn splicing carriage.

Figure 6 is a diagram showing an example of contents stored in a RAM in the carriage control device.

Figure 7 is a diagram showing how a yarn is unwound and found from a winding package.

Figure 8 is a diagram showing control of a LED display section of the yarn splicing carriage.

Detailed Description of the Preferred Embodiment

[0020] Now, an embodiment of the present invention will be described. Figure 1 is a front view showing the entire configuration of a spinning device in accordance with an embodiment of the present invention. Figure 2 is a vertical side view of the spinning device in accordance with the embodiment of the present invention. Figure 3 is a block diagram of the spinning device.

[0021] Figure 1 is a spinning device 1 which is one example of textile machines, comprising a large number of spinning units (yarn processing units) 2 arranged in a line. The spinning device 1 is provided with a yarn splicing carriage 3, a blower box 4, and a motor box 5. The yarn splicing carriage 3 can run in the direction in which the winding units 2 are arranged. A main body control device 61 is provided in the motor box 5 to integrally control the whole spinning device 1.

[0022] As shown in Figure 1, each of the spinning units 2 is mainly composed of a draft device 7, a spinning section 9, a yarn feeding device 11, a cutter device (discontinuing means) 51, a yarn clearer (yarn defect detector) 52, and a winding section 12.

[0023] The draft device 7 is provided near an upper end of a casing 6 of a spinning device 1 main body. A
spinning section 9 spins a bundle of fibers 8 fed by the draft device 7. The yarn feeding device 11 feeds a spun yarn 10 discharged by the spinning section 9. The spun yarn 10 passes through the cutter device 51 and the yarn clearer 52 and is then wound by a winding section 12 to form a winding package 45.

[0024] As shown in the block diagram in Figure 3, a unit controller 32 is provided in each of the spinning units 2 to control the draft device 7, the spinning section 9, and other sections. The unit controller 32 is configured as a well-known microcomputer. The unit controller 32 comprises a CPU (not shown in the drawings), timer circuit (not shown in the drawings), a RAM (storage section) 33, and the like. The unit controller 32 in each spinning unit 2 is connected to a main body control device 61 by a signal line so as to be controlled by the main body control device 61.

[0025] As shown in Figure 2, the draft device 7 draws a sliver 13 into the fiber bundle 8. The draft device 7 is composed of four pairs of rollers, namely, a pair of back rollers 14, a pair of third rollers 15, a pair of middle rollers 17 and a pair of front rollers 18. An apron belt 16 is installed around each of the middle rollers 17.

[0026] The yarn feeding device 11 is composed of a delivery roller 39 supported by the casing 6 of the spinning device 1 main body and a nip roller 40 provided in contact with the delivery roller 39. In this configuration, the spun yarn 10 discharged by the spinning section 9 is sandwiched between the delivery roller 39 and the nip roller 40. Then, the delivery roller 39 is driven to feed the spun yarn 10 to the winding section 12.

[0027] The winding section 12 comprises a cradle arm 71 supported by a support shaft 70 so that it can pivot around the support shaft 70. The cradle arm 71 can rotatably support a bobbin around which the spun yarn 10 is wound. In addition, the winding section 12 comprises a winding drum 72 that can be abutted against a peripheral surface of the bobbin or of a winding package 45 formed by winding the spun yarn 10 around the bobbin. The winding drum 72 is driven by an electric motor (not shown in the drawings) to rotate the bobbin or the winding package 45 in contact with the winding drum 72. Thus, the spun yarn 10 is wound around the bobbin or the winding package 45.

[0028] Further, the cradle arm 71 comprises an urging spring 73 that exerts an urging force on the cradle arm 71 in the direction in which the peripheral surface of the winding package 45 is separated from the winding drum 72. On the other hand, an attraction arm 74 is projected from the base of the cradle arm 71. A attraction plate 75 composed of an iron plate is fixed to the tip of the attraction arm 74. An electromagnet 76 is installed in proximity to the attraction plate 75. The electromagnet 76 is switched on and off in accordance with a control signal from the unit controller 32.

[0029] In the above configuration, the unit controller 32 normally keeps the electromagnet 76 switched "on" to attract the attraction plate 75 and to rotate the winding package 45 in contact with the winding drum 72. On the other hand, when a yarn defect occurs, and the spinning and winding operations are thus to be stopped, the unit controller 32 switches off the electromagnet 76 to stop attracting the attraction plate 75. The urging spring 73 then separates the winding package 45 from the winding drum 72. As a result, the winding package 45 stops rotating.

[0030] As shown in Figure 2, the cutter device 51 and the yarn clearer 52 are provided in front of the case 6 of the spinning device 1 and slightly below the yarn feeding device 11. The spun yarn 10 spun out by the spinning section 9 passes through the cutter device 51 and the yarn clearer 52 before being wound by the winding section 12. The yarn clearer 52 monitors the thickness of the traveling spun yarn 10. If the yarn clearer 52 detects a yarn defect in the spun yarn 10, a control section 53 (Figure 3) for the yarn clearer 52 transmits a yarn defect detection signal to the unit controller 32.

[0031] The yarn clearer 52 optically or electrostatically detects, for example, the thickness of a passing yarn. The control section 53 for the yarn clearer 52 can determine the plural types of yarn defects on the basis of the detected thickness and length. For example, if a thickness at least twice as large as a normal one extends several centimeters or longer, this is detected as an S defect (short defect). Further, if a thickness slightly larger or smaller than normal one extends several meters or longer, this is detected as a T or L defect (long defect). Among the information on the yarn processing status observed upon the occurrence of the yarn defect, information on the type of the yarn defect (detecting process information indicating whether the defect is short or long) is contained in the yarn defect detection signal issued by the control section 53 for the yarn clearer 52.

[0032] Upon receiving the yarn defect detection signal, the unit controller 32 immediately actuates the cutter device 51 to cut the spun yarn 10 upstream of the yarn clearer 52. The unit controller 32 further controls to stop the draft device 7 and controls the yarn splicing carriage 3 to run to the spinning unit 2. Subsequently, the draft device 7 and the like are driven again and the yarn splicing carriage 3 removes the yarn defect and splices the yarn. The spinning and winding operations are then resumed. This control will be described later in detail.

[0033] As shown in Figure 1, the yarn splicing carriage 3 runs on a rail 41 provided in the casing 6 of the spinning device 1 main body. As shown in Figures 1 and 2, the yarn splicing carriage 3 comprises a yarn splicing device (for example, a yarn splicer) 43, a yarn end catching and guiding pipe 44 and a suction mouth (catching and guiding means) 46. The yarn end catching and guiding pipe 44 is provided on the yarn splicing carriage 3 in manner that the yarn end catching and guiding pipe 44 can be freely laid and raised. While pivoting around a shaft, the yarn end catching and guiding pipe 44 sucks, catches a yarn end discharged from the spinning section 9, and then guides the yarn end to the yarn splicing device 43.
The suction mouth 46 is provided on the yarn splicing carriage 3 in manner that the suction mouth 46 can be freely laid and raised. While pivoting around a shaft, the suction mouth 46 approaches to the winding package 45 rotatably supported by the winding section 12, catches a yarn end of the winding package and then guides the yarn end to the yarn splicing device 43.

As shown in Figure 2, a mouth pivoting motor 57 is provided to pivot the suction mouth 46. Further, a suction pipe 50 is connected to a pivoting base of the suction mouth 46. An extra yarn end or the like which is cut during a yarn splicing operation performed by the yarn splicing device 43 is discharged via the suction mouth 46 and the suction pipe 50. A suction detecting sensor (detecting means) 54 is installed in the suction pipe 50. Upon detecting the spun yarn 10 inside the suction pipe 50, the suction detecting sensor 54 transmits a yarn end detection signal to a carriage control device 48. The suction mouth 46 is provided on the yarn splicing device 43 is discharged via the suction mouth 46 and the suction pipe 50. The reverse rotation motor 56 then drives the reverse rotation roller 55 to allow the winding package 45 to be reversely rotated.

As shown in Figure 3, the yarn splicing carriage 3 comprises the carriage control device 48, which is configured as a well-known microcomputer composed of a CPU (not shown in the drawings), a RAM 49, and the like. The carriage control device 48 controls the yarn splicing carriage 3 to run and controls the above mentioned components according to a request from the unit controller 32 in the spinning unit 2. The carriage control device 48 thus controls the yarn splicing carriage 3 to perform a yarn splicing operation and a yarn defect removing operation on that spinning unit 2.

Further, a LED display section 47 composed of a seven segment LED is provided in the front of the yarn splicing carriage 3. The carriage control device 48 controls the display on the LED display section 47 (this will be described below in detail).

A description will be given of operations of the spinning device 1 configured as described above. First, with reference to Figure 4, a description will be given of the control of the unit controller 32 in each spinning unit 2. First, in S101, the unit controller 32 checks whether or not a yarn defect detection signal has been received from the yarn clearer 52. If a yarn defect detection signal has been received, the unit controller 32 acquires the type of a yarn defect contained in the yarn defect detection signal. The unit controller 32 then stores information of the acquired type of the yarn defect and the calculated diameter in the RAM 33 as information on the yarn processing status observed upon the occurrence of the yarn defect (S102).

As a result, the RAM 33 stores information indicating whether a long or short yarn defect is occurring, the diameter of the winding package 45, and the presence or absence of a yarn splicing request as shown to the right of S102 in Figure 4.

If a yarn defect occurs, the information on the yarn splicing request stored in the RAM 33 indicates that a "yarn splicing request has been made". Figure 4 shows, to the right of S102, an example of contents stored in the RAM 33 if the yarn clearer 52 detects a long defect when a winding operation is started.

In the present embodiment, the diameter of the winding package 45 is divided into eight levels ranging from the status at the start of the winding operation to the status of a full package. The level to which the diameter corresponds is stored using numerical values "1" to "8". That is, "1" is stored to indicate the status at the start of the winding operation, whereas "8" is stored to indicate the status of a full package.

Further, almost simultaneously with the process of storing information in the RAM 33 in S102, the unit controller 32 controls the cutter device 51 to cut a yarn. Accordingly, a yarn end is formed. The unit controller 32 further performs control such that the electromagnet 76 is turned off to stop attracting the attraction plate 75 and separate the winding drum 72 from the winding package 45 by the urging spring 73. As a result, the downstream spun yarn 10 (including the yarn defect portion detected by the yarn clearer 52) cut by the cutter device 51 is wound around the winding package 45 rotated by inertia. If the yarn defect detection signal has not been received, neither the process in S102 nor the yarn cutting process is executed.

Then, the unit controller 32 checks whether or not a yarn defect removal success signal (indicating that the yarn defect has been successfully removed; this signal will be described below in detail) has been received from the yarn splicing carriage 3 (S103). If a yarn defect removal success signal has been received, the unit controller 32 resets the information on the type of the yarn defect and the diameter of the winding package 45 stored in the RAM 33. The unit controller 32 then stores information indicative of no yarn defects and no yarn splicing requests in the RAM 33 (S104). The contents stored in the RAM 33 after the resetting operation are shown to the right of S104 in Figure 4. If the yarn defect removal success signal has not been received, the processing in S104 is not executed.

The unit controller 32 then transmits the information on the yarn defect stored in the RAM 33 to the main body control device 61 (S105). In S105, even if no yarn defects are occurring and the information stored in the RAM 33 is indicative of "no yarn defects" and "no yarn splicing requests", the unit controller 32 notifies the main body control device 61 of information indicative of no yarn defects and no yarn splicing requests. Further,
the transmitted signal contains information (identification information on the spinning unit 2) on the number pre-assigned to that spinning unit 2.

[0045] Upon receiving the information on the yarn defect, the main body control device 61 transfers the information to the carriage control device 48 for the yarn splicing carriage 3. After the transmitting process, the main body control device 61 returns to S101 to repeat the above processing.

[0046] Now, with reference to Figure 5 and the like, a description will be given of control performed by the carriage control device 48 for the yarn splicing carriage 3. Figure 5 is a flowchart showing control performed by the carriage control device for the yarn splicing carriage. Figure 6 is a diagram showing an example of contents stored in the RAM in the carriage control device. Figure 7 is a diagram showing how a yarn is unwound and led out from the winding package.

[0047] First, the carriage control device 48 receives and acquires information on the presence or absence of a yarn defect, information on the yarn processing status observed upon the occurrence of the yarn defect (the type of the detected yarn defect and the diameter of the winding package 45), and information on the presence or absence of a yarn splicing request, the information having been transmitted by each spinning unit 2. The carriage control device 48 returns the contents of the RAM 49 in accordance with information (S201). As shown in Figure 6, the RAM 49 can store the presence or absence of a yarn defect, the information on the yarn processing status observed upon the occurrence of the yarn defect (the type of the detected yarn defect and the diameter of the winding package 45), and the presence or absence of a yarn splicing request in association with the serial number of each spinning unit 2.

[0048] Repeating the process in S201 (reception of the information on the presence or absence of a yarn defect, the information on the yarn processing status observed upon the occurrence of the yarn defect, and the information on the presence or absence of a yarn splicing request; and an operation of writing the information to the RAM 49) results in the constant storage, for each spinning unit, of the latest information on the yarn processing status observed upon the occurrence of the yarn defect and the diameter of the winding package 45, and the presence or absence of a yarn splicing request in association with the serial number of each spinning unit 2.

[0049] Then, the carriage control device 48 reads the information from the RAM 49 to check whether or not any spinning unit 2 is making a yarn splicing request (S202 in Figure 5). When no spinning unit 2 is making a yarn splicing request, the carriage control device 48 returns to S201.

[0050] If at least one spinning unit 2 is making a yarn splicing request, the carriage control device 48 determines which of the spinning units 2 is to be subjected to removal of a yarn defect and a yarn splicing operation (operation target unit) (S203). A possible method for determining the operation target unit will be described below. If a yarn defect is occurring in only one spinning unit 2, Such spinning unit 2 may be determined to be the operation target unit. If a yarn defect is occurring in a plurality of spinning units 2, the spinning unit 2 closest to the current position of the yarn splicing carriage 3 may be determined to be the operation target unit. Since the RAM 49 in the carriage control device 48 stores the information on the presence or absence of a yarn splicing request for all the spinning units 2 as shown in Figure 6, the carriage control device 48 can easily execute the above determining process.

[0051] Once the operation target unit is determined, the carriage control device 48 executes the processing in S204. Specifically, the carriage control device 48 reads and acquires, from the RAM 49, the type of the yarn defect and the diameter of the winding package 45 for the operation target unit. On the basis of this information, the carriage control device 48 inquires of the main body control device 61 about the time required for the suction mouth 46 to catch the yarn end during a yarn end finding operation as well as the speed of the reverse rotation roller 55. Here, in the present embodiment, the time required to catch the yarn end refers to the amount of time from when the suction mouth 46 approaches the winding package 45 until when the suction mouth 46 starts to move to the yarn splicing device 43.

[0052] In this case, the RAM 62 in the main body control device 61 pre-stores the time required for the suction mouth 46 to catch the yarn end as well as the speed (referred to as the "reserve rotation speed" below) of the reverse rotation roller 55 in association with the type of the yarn defect and the diameter of the winding package 45; the time and the speed are considered to be suitable for a yarn end finding operation.

[0053] If, for example, the winding package 45 has a small diameter, when the reverse rotation roller 55 is brought into contact with the winding package 45, having a short circumference, and is then rotated at a high speed, the winding package 45 is reversely rotated at an excessively high speed. Accordingly, the unwound yarn end is violently swung around. This makes it difficult for the suction mouth 46 to suck and catch the yarn end, resulting in frequent yarn end finding mistakes. On the other hand, if the winding package 45 has a large diameter, when the reverse rotation roller 55 is brought into contact with the winding package 45 and then rotated at a low speed, a single rotation of the winding package 45 requires a long time because of the long circumference of the winding package 45. This reduces the efficiency of the yarn end finding operation. Thus, the RAM 62 contains the relationship between the speed of the reverse rotation roller 55 and the diameter of the winding package.
The speed of the reverse rotation roller 55 increases consistently with the diameter of the winding package 45.

[0054] In case of the long yarn defect, the yarn defect extends a long distance (for example, several meters) from the yarn end. Accordingly, the spun yarn 10 must be unwound and removed from the winding package 45 by a long length. On the other hand, in case of the short yarn defect, the spun yarn 10 needs to be removed from the winding package 45 only by a short length. In this case, unwinding the yarn by a long length results in a waste of the yarn. Thus, the relationship between the yarn end catching time and the yarn defect type is defined in the RAM 62 so that a longer yarn defect requires a longer time for the suction mouth 46 to catch the yarn defect, while a shorter yarn defect requires only a shorter time for the suction mouth 46 to catch the yarn defect. Since the speed at which the spun yarn 10 is unwound from the winding package 45 increases consistently with the speed of the reverse rotation roller 55, the yarn end catching time is set taking the speed of the reverse rotation roller 55 into account.

[0055] In response to the inquiry signal, the main body control device 61 notifies the carriage control device 48 for the yarn splicing carriage 3 of the yarn end catching time and the reverse rotation speed on the basis of the information stored in the RAM 62 as described above. Thus, the carriage control device 48 can acquire the yarn end catching time and reverse rotation speed suitable for a yarn end finding operation, for the operation target unit 2. The processing in S204 has been described.

[0056] Then, the carriage control device 48 controls the yarn splicing carriage 3 to run to the operation target unit 2 determined in the processing in S203. The yarn splicing carriage 3 is then controlled to stop at the operation target unit 2 (S205). Subsequently, the carriage control device 48 drives a mouth pivoting motor 57 to rotatevly move the suction mouth 46 downward. The suction mouth 46 is caused to approach the surface of the winding package 45, so that a suction flow acts on the winding package 45. The carriage control device 48 further controls to contact the reverse rotation roller 55 with the winding package 45 and to rotate the reverse rotation roller 55 at the reverse rotation speed (S206). Although not shown in the flowchart in Figure 5, the carriage control device 48 then transmits a spinning start signal to the operation target unit 2 to cause the spinning section 9 to resume the spinning operation. Further, the yarn end catching and guiding pipe 44 is rotatively moved upward to suck and catch the yarn 10 newly spun by the spinning section 9 (see Figure 7).

[0057] As shown in Figure 7, by the control in S206, the winding package 45 rotates in the direction (unwinding direction) opposite to the yarn winding direction. The spun yarn 10 is unwound and sucked into the suction mouth 46. Owing to the reverse rotation of the winding package 45 and the suction flow from the suction mouth 46, the unwound spun yarn 10 advances through the suction mouth 46 and suction pipe 50. The suction detecting sensor 54 then detects the spun yarn 10.

[0058] As shown in the flowchart in Figure 5, the carriage control device 48 determines whether or not a yarn end detection signal has been received from the suction detecting sensor 54 within a predetermined time after the suction mouth 46 started to suck the peripheral surface of the winding package 45 (the reverse rotation roller 55 started to reversely rotate the winding package 45) (S207). If the yarn end detection signal has not been received within the predetermined time, then for example, the yarn end of the spun yarn 10 may be buried in a yarn layer in the winding package 45, and a yarn end finding operation cannot be carried out. Accordingly, the carriage control device 48 suspends the yarn splicing operation (S208) and transmits an error signal to the main body control device 61. The carriage control device 48 then returns to the processing in S201 to wait for a yarn defect to occur in another spinning unit 2.

[0059] If the yarn end detection signal has been received within the predetermined time, the carriage control device 48 controls to reversely rotate the winding package 45 while continuously controlling the suction mouth 46 located close to the winding package 45 to suck the yarn end of the winding package 45 for the yarn end catching time aquired at the processing in S204 (S209). As a result, the spun yarn 10 is unwound from the winding package 45 by a length corresponding to the type of the yarn defect. It is thus possible to suck and catch a piece of the spun yarn 10 having a sufficient length and including the yarn defect part, in the suction mouth 46.

[0060] When the yarn end catching time is elapsed, the carriage control device 48 rotatively moves the yarn end catching and guiding pipe 44 downward, while rotatively moving the suction mouth 46 upward. Thus, the yarns sucked and caught by the yarn end catching and guiding pipe 44 and the suction mouth 46 are guided to the yarn splicing device 43. Then, the yarn splicing device 43 performs a yarn splicing operation (S210).

[0061] A piece of the spun yarn 10 having a sufficient length and including the yarn defect part is unwound and drawn out before the yarn splicing device 43 starts a yarn splicing operation. This prevents the yarn defect from remaining in the spliced yarn and being wound around the winding package 45. An extra yarn (including the yarn defect part) is cut by cutting means (cutter) in the yarn splicing device 43 and then sucked into the suction mouth 46 and discharged via the suction pipe 50. That is, the yarn splicing device 43 also serves as yarn defect removing means. The series of yarn splicing operations are thus finished, and the spinning and winding operations are resumed.

[0062] Once the yarn splicing device 43 finishes the yarn splicing operation, the carriage control device 48 transmits a yarn defect removal success signal to the unit controller 32 in the operation target unit 2 via the main body control device 61 (S211). Then, the carriage control device 48 returns to the first step S201 to wait for
a yarn defect to occur in any spinning unit 2. [0063] Upon receiving the yarn defect removal success signal, the unit controller 32 in the operation target unit 2 executes the processing in S104 shown in Figure 4 to reset the information on the yarn defect in the RAM 33. The contents stored in the RAM 33 change to “no yarn defects” and “no yarn splicing requests”. By the processing in S105, the reset contents of the RAM 33 are transmitted to the yarn splicing carrier 3 via the main body control device 61. Consequently, the processing in S201 (Figure 5), previously described, also are changed the contents of the RAM 49 in the carriage control device 48 to “no yarn defects” and “no yarn splicing requests” for the operation target unit 2. The yarn defect removal success signal corresponds to a reset signal.

[0064] As shown above, in the spinning device 1 in accordance with the present embodiment, the carriage control device 48 for the yarn splicing carriage 3 acquires and stores, in the RAM 49, the information on the presence or absence of a yarn defect and the yarn processing status observed upon the occurrence of the yarn defect for each spinning unit 2. When the yarn splicing carriage 3 removes a yarn defect from the spinning unit 2 in which the yarn defect is occurring and performs a yarn splicing operation on the spinning unit 2 in which the yarn defect is occurring, the carriage control device 48 controls the suction mouth 46 and the reverse rotation roller 55 on the basis of the acquired information on the yarn processing status observed upon the occurrence of the yarn defect.

[0065] With the conventional configuration (for example, the Unexamined Japanese Patent Application Publication (Tokkai-Hei) No. 2001-40532), when the yarn splicing carriage can not be removed a yarn defect in a yarn processing, the yarn processing unit is stopped and the operator performs a required operation. However, in the present embodiment, the above configuration enables the carriage control device 48 for the yarn splicing carriage 3 to control the suction mouth 46 and the reverse rotation roller 55 on the basis of the information on the yarn processing status observed upon the occurrence of the yarn defect. This allows the yarn splicing carriage 3 to remove yarn defects and perform a yarn splicing operation in a short time without wasting the spun yarn 10. Moreover, the carriage control device 48 for the yarn splicing carriage 3 can collectively manage the information on the presence or absence of a yarn defect and the yarn processing status observed upon the occurrence of the yarn defect for all the spinning units 2. This makes it possible to easily determine which of the plurality of spinning units 2 is to be subjected to removal of a yarn defect and a yarn splicing operation by the yarn splicing carriage 3 (processing in S203 in Figure 5).

[0066] Further, in the present embodiment, the suction mouth 46 approaches the surface of the winding package 45 and catches the yarn end and guides the caught yarn end to the yarn splicing device 43. During a yarn end finding operation, the carriage control device 48 varies the time (yarn end catching time) required for the suction mouth 46 to catch the yarn end, depending on the information on the yarn processing status observed upon the occurrence of the yarn defect (specifically, depending on whether the yarn defect is long or short).

[0067] Accordingly, by controllably increasing the yarn end catching time for the suction mouth 46 for a long defect, while reducing the yarn end catching time for a short defect, it is possible to reliably suck and catch the entire yarn defect in the suction mouth 46. Further, for a short defect, a sucking and catching operation is performed for only a short time. This makes it possible to reduce the time required for a yarn end catching operation.

[0068] Furthermore, the yarn splicing carriage 3 is provided with the suction detecting sensor 54 that detects the spun yarn 10 sucked into the suction mouth 46. The carriage control device 48 controllably varies the amount of time from when the suction detecting sensor 54 detects the spun yarn 10 until when the yarn splicing device 43 performs a yarn splicing operation, depending on whether the yarn defect is long or short (S209 in Figure 5).

[0069] That is, a control is performed on the yarn end catching time from when the suction detecting sensor 54 detects the unwound yarn 10 (when the suction detection sensor 54 confirms that a yarn end finding operation has succeeded) until when the suction mouth 46 guides the yarn to the yarn splicing device 43. Consequently, the entire yarn defect can be reliably caught and sucked into the suction mouth 46 before a yarn splicing operation is started. This prevents, for example, the following situation: before a long defect has been entirely caught and sucked into the suction mouth 46, the yarn is guided to the yarn splicing device 43 and then spliced by the device 43, so that the long defect is partly wound around the winding package 45 to degrade quality.

[0070] In the present embodiment, the yarn splicing carriage 3 comprises the reverse rotation roller 55 that rotates the winding package 45 in the yarn unwinding direction. The yarn splicing carriage 3 can acquire and store, in the RAM 49, the information on the diameter of the winding package 45 measured upon the occurrence of a yarn defect for each spinning unit 2 (Figure 6). Then, during a yarn end finding operation, the speed of the reverse rotation roller 55 contacted with the winding package 45 is controllably varied depending on the diameter of the winding package 45.

[0071] Accordingly, the situations described below can be prevented by varying the speed of the reverse rotation roller 55 depending on the diameter of the winding package 45. When the winding package 45 has a small diameter, the unwound yarn end is swung at a high speed and cannot be successfully sucked and caught in the suction mouth 46, resulting in a yarn end finding mistake. When the winding package 45 has a large diameter, it takes the suction mouth 46 a long time to suck and catch the yarn. That is, it is possible to increase the success rate of a yarn end finding operation and to reduce the time...
required for the yarn end finding operation.

[0072] In the present embodiment, if the winding package 45 has a large diameter when a yarn defect occurs, when the reverse rotation roller 55 is reversely rotating the winding package 45 (during at least initial several rotations), the reverse rotation speed of the reverse rotation roller 55 is controllably increased.

[0073] Consequently, when the diameter of the winding package 45 is small, the reverse rotation roller 65 is rotated at a low speed during the initial period of yarn unwinding. When the diameter of the winding package 45 is large, the reverse rotation roller 65 is rotated at a high speed during the initial period of yarn unwinding. This makes it possible to reduce the number of mistakes (yarn end finding mistakes) in a sucking operation performed by the suction mouth 46 and to shorten the time required for the yarn end finding operation.

[0074] In the present embodiment, each of the spinning units 2 comprises the RAM 33. When the yarn clearer 52 detects a yarn defect, the RAM 33 stores the information on the presence or absence and the type of the yarn defect (S102 in Figure 4). The information is then output to the yarn splicing carriage 3 (S105). Then, when the yarn splicing carriage 3 completes removing the yarn defect from the spinning unit (operation target unit) 2 in which the yarn defect is occurring and performing a splicing operation on the spinning unit, the information stored in the RAM 33 in the spinning unit 2 is erased and reset to "no yarn defects" and "no yarn splicing requests" (S104).

[0075] Accordingly, if the yarn splicing carriage 3 has failed in the yarn splicing operation and yarn defect removing operation (for example, the processing in S207 to S208 in Figure 5 has been executed), control is performed such that the spinning unit 2 continues to output the information (the presence of the yarn defect and the like) (S105 in Figure 4). This enables the main body control device 61 or the yarn splicing carriage 3 to recognize that the operations have not been completed yet and that the winding operation cannot be resumed.

[0076] Now, with reference to Figure 8, a description will be given of control of the LED display section 47 on the yarn splicing carriage 3. In the flowchart in Figure 8, the carriage control device 48 acquires information indicating the current position of the yarn splicing carriage 3 (indicating at which spinning unit 2 the yarn splicing carriage 3 is located) in accordance with an output signal from position recognizing means provided in the yarn splicing carriage 3 (not shown in the drawings; for example, a dog sensor that reads a dog provided in each spinning unit 2, a bar code reader that reads bar codes, or a rotary encoder provided on a wheel of the carriage 3) (S301). Then, the carriage control device 48 checks whether or not any yarn defect is occurring in the spinning unit 2 at which the yarn splicing carriage 3 is located, on the basis of the contents stored in the RAM 49 (S302).

[0077] If a yarn defect is occurring in the spinning unit 2, the type of the yarn defect (long or short) is displayed on the LED display section 47 based on the seven segment scheme (S303). Any of various display manners may be used. For example, the LED display section 47 may display "L" for a long defect and "S" for a short defect.

[0078] Then, the carriage control device 48 returns to the processing in the first S301.

[0079] On the other hand, if no yarn defects are occurring, the serial number of the spinning unit 2 is displayed on the LED display section 47 (S304). For example, if the yarn splicing carriage 3 is running by the spinning unit 2 No. 3 (#3), "3" is displayed on the LED display section 47. In this case, the carriage control device 48 also returns to the first S301.

[0079] With this control, if, for example, the RAM 49 stores such contents as shown in Figure 6 and the yarn splicing carriage 3 runs in front of the spinning units 2 Nos. 1 to 6, the display on the LED display section 47 changes, for example, from "1" through "2", "3", "L", and "5", to "6" in this order. Upon viewing this, the operator can easily determine the following two points: a yarn defect is occurring in the spinning unit 2 No. 4, whereas no yarn defects are occurring in the other spinning units 2, and a long yarn defect is occurring in the spinning unit 2 No. 4. Further, while the yarn splicing carriage 3 is stopped for a yarn splicing operation at the spinning unit 2 No. 7 in which a yarn defect is occurring, the LED display section 47 displays "S". Upon viewing this, the operator can easily determine that the yarn splicing carriage 3 is removing a short yarn defect.

[0080] As shown above, in the spinning device 1 in accordance with the present embodiment, the yarn splicing carriage 3 comprises the LED display section 47. Further, when the yarn splicing carriage 3 lies opposite the spinning unit 2 in which a yarn defect is occurring, the type of the yarn defect is displayed on the LED display section 47.

[0081] Accordingly, by viewing the LED display section 47 on the yarn splicing carriage 3, the operator can easily determine the type of the yarn defect occurring in the spinning unit 2.

[0082] The preferred embodiment of the present invention has been described above. However, the present invention may be varied as described below.

1. The configuration of the present invention is applicable to any textile machines different from the spinning machine 1 provided that the textile machines have a yarn splicing carriage.

2. The present invention is not limited to the types of yarn defects that are stored in the RAM 33 in the spinning unit 2 and in the RAM 49 in the yarn splicing carriage 3. For example, an S defect, an L defect, and a T defect are stored so that the suction mouth 46 and the reverse rotation roller 55 can be controlled on the basis of this information.

3. The diameter of the winding package 45 is arithmetically acquired in accordance with the length of the spun yarn produced in the spinning section 9.
However, for example, a rotation sensor may be provided in the winding section 12 so that the diameter can be arithmetically acquired by counting the rotation number of the winding package 45. Further, the present invention is not limited to the eight levels into which the diameter of the winding package 45 is classified. For example, four or sixteen levels may be used.

(4) The method for discontinuing the yarn is not limited to the process of cutting the yarn using the cutter device 51. For example, a clamp device may be used to tear off the yarn or the winding section 9 may be caused to stop the spinning operation so that the yarn end is formed.

(5) The position where the suction detecting sensor 54 is installed is not limited to the suction pipe 50. The suction detecting sensor 54 may be installed in, for example, the suction mouth 46.

(6) The LED display section 47 is not limited to the seven segment LED. For example, a simple LED may be used or the type of a yarn defect may be displayed on a liquid crystal display.

(7) The carriage control device 48 may be provided in the motor box 5 instead of the yarn splicing carriage 3.

Claims

1. A textile machine comprising a plurality of yarn processing units arranged in a line, a yarn splicing carriage and a control device for the yarn splicing carriage, each of the yarn processing units comprising a winding section which winds a yarn into a winding package, a yarn defect detector which detects a defect in a yarn traveling to the winding section and which can determine the type of the yarn defect, and discontinuing means for discontinuing the yarn in accordance with detection of the yarn defect carried out by the yarn defect detector, the yarn splicing carriage capable running along a direction in which the yarn processing units are arranged, performing a yarn splicing operation in accordance with a yarn splicing request from the yarn processing units, and comprising yarn end finding means for finding a yarn end from the winding package 45 by the yarn defect detector, a yarn end finding means includes control of the speed of the reverse rotation means on the diameter of the winding package observed upon occurrence of the yarn defect, and the control device is configured to acquire information on the presence or absence of a yarn defect and information on a yarn processing status observed upon occurrence of the yarn defect, and when the yarn splicing carriage removes a yarn defect from a yarn processing unit in which the yarn defect is occurring and performs a splicing operation on the yarn processing unit, the control device controls the yarn end finding means of the yarn splicing carriage in accordance with the acquired information on the yarn processing status observed upon occurrence of the yarn defect.

2. A textile machine according to Claim 1, characterized in that the yarn end finding means includes catching and guiding means which approaches to a surface of the winding package to catch the yarn end and guide the yarn end to the yarn splicing device, and the control of the yarn end finding means includes controlling a yarn end catching time of the catching and guiding means in accordance with the information on the yarn processing status observed upon occurrence of the yarn defect.

3. A textile machine according to Claim 2, characterized in that the yarn splicing carriage is provided with detecting means for detecting the yarn caught by the catching and guiding means, and the yarn end catching time of the catching and guiding means is controlled in accordance with detection of the yarn carried out by the detecting means.

4. A textile machine according to any one of Claims 1 to 3, characterized in that the control device for the yarn splicing carriage is configured to acquire information on the diameter of the winding package for each yarn processing unit, the information on the diameter of the winding package constituting the information on the yarn processing status observed upon occurrence of the yarn defect, and in that the yarn end finding means includes reverse rotation means for rotating the winding package in a direction in which the yarn is unwound, and the control of the yarn end finding means includes control of the speed of the reverse rotation means on the diameter of the winding package.

5. A textile machine according to Claim 4, characterized in that control is performed such that as the diameter of the winding package observed upon occurrence of the yarn defect is large, a reverse rotation speed of the reverse rotation means is increased.

6. A textile machine according to any one of Claims 1 to 5, characterized in that each of the yarn processing units comprises a storage section, and when the yarn defect detector detects a yarn defect, the storage section stores the information on the presence of the yarn defect and the yarn processing status observed upon occurrence of the yarn defect and outputs the stored information to the control device.
for the yarn splicing carriage, and in that once the yarn splicing carriage completes removing the yarn defect from the yarn processing unit in which the yarn defect is occurring and performing a yarn splicing operation on the yarn processing unit, the information stored in the storage section of the yarn processing unit is reset.

7. A textile machine according to any one of Claims 1 to 6, characterized in that the yarn splicing carriage comprises display means, and when the yarn splicing carriage is located at the yarn processing unit in which a yarn defect is occurring, the display means can display the type of the yarn defect in the yarn processing unit.
FIG. 3
START

RECEIVE INFORMATION ON YARN DEFECT FOR EACH UNIT S201

YARN SPLICING REQUEST MADE BY ANY UNIT? S202

N

Y

DETERMINE OPERATION TARGET UNIT S203

ACQUIRE YARN END CATCHING TIME AND REVERSE ROTATION SPEED IN ACCORDANCE WITH TYPE OF YARN DEFECT AND DIAMETER OF WINDING PACKAGE S204

YARN SPLICING CARRIAGE RUNS TO OPERATION TARGET UNIT S205

MOVE SUCTION MOUTH CLOSER TO PACKAGE AND CONTACT REVERSE ROTATION ROLLER WITH PACKAGE AND DRIVE ROLLER AT REVERSE ROTATION SPEED S206

S207

DETECT YARN BY SENSOR WITHIN PREDETERMINED TIME? N

S208

SUSPEND YARN SPLICING OPERATION

Y

CONTINUE SUCTION AND REVERSE ROTATION UNTIL YARN END CATCHING TIME ELAPSES S209

USE SUCTION MOUTH TO GUIDE YARN TO YARN SPICING DEVICE FOR YARN SPICING OPERATION S210

TRANSMIT YARN DEFECT REMOVAL SUCCESS SIGNAL TO OPERATION TARGET UNIT S211
<table>
<thead>
<tr>
<th>SERIAL NUMBER OF SPINNING UNIT</th>
<th>TYPE OF YARN DEFECT</th>
<th>DIAMETER OF WINDING PACKAGE</th>
<th>YARN SPlicing REQUEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ABSENT</td>
<td>ABSENT</td>
<td>ABSENT</td>
</tr>
<tr>
<td>2</td>
<td>ABSENT</td>
<td>ABSENT</td>
<td>ABSENT</td>
</tr>
<tr>
<td>3</td>
<td>ABSENT</td>
<td>ABSENT</td>
<td>PRESENT</td>
</tr>
<tr>
<td>4</td>
<td>ABSENT MEET DEFECT</td>
<td>2</td>
<td>ABSENT</td>
</tr>
<tr>
<td>5</td>
<td>ABSENT MEET DEFECT</td>
<td>7</td>
<td>ABSENT</td>
</tr>
<tr>
<td>6</td>
<td>SHORT DEFECT</td>
<td>7</td>
<td>ABSENT</td>
</tr>
<tr>
<td>7</td>
<td>ABSENT</td>
<td>8</td>
<td>.</td>
</tr>
<tr>
<td>8</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>
FIG. 8

START

ACQUIRE PRESENT POSITION OF YARN SPLICING CARRIAGE

S301

LOCATED OPPOSITE UNIT IN WHICH YARN DEFECT IS OCCURRING?

S302

Y

DISPLAY TYPE OF YARN DEFECT ON LED

S303

N

DISPLAY UNIT NUMBER ON LED

S304