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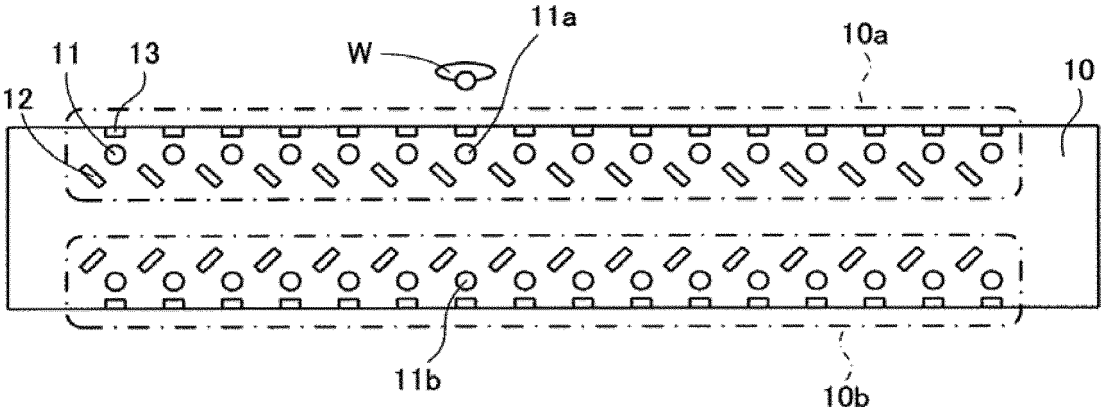
(54) RING SPINNING MACHINE COMPRISING AN APPARATUS FOR ASSISTING IN YARN PIECING

(57) A ring spinning machine (10) that includes an apparatus for assisting in yarn piecing is provided. The apparatus includes a position detector (21), at least one guide (13, 30) that guides a worker (W) to a position of one of the spindles (11, 41, 42, 43, 44) having a yarn break, and a controller (25) that controls the guide (13, 30) based on the position of a spindle (11, 41, 42, 43, 44) having the yarn break and a location of the worker (W). The position detector (21) includes a state memory (22) and a worker's position determiner (23) that, when a state of any of the spindles (11, 41, 42, 43, 44) is changed from a yarn break state to a non-yarn break state, determines that the position of the spindle (11, 41, 42, 43, 44) as the location of the worker (W).

FIG. 2



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a ring spinning machine comprising an apparatus for assisting in yarn piecing.

[0002] When a yarn break occurs at one of spindles of a ring spinning machine, a worker moves to the spindle having the yarn break and performs yarn piecing operation. An apparatus for assisting in yarn piecing that guides workers to the position of the spindle having a yarn break is known. For example, according to the ring spinning machine comprising an apparatus for assisting in yarn piecing disclosed in Japanese Unexamined Patent Application Publication No. 2015-227520, two motion sensors are provided to each spinning machine so as to detect or determine a location of a worker, and the apparatus guides the worker to a spindle having a yarn break based on the detected location of the worker.

[0003] However, the conventional apparatuses for assisting in yarn piecing have a problem that sensors for detecting the location of workers need be added to the spinning machines.

[0004] The present invention which has been made in view of the above problem is directed to providing a ring spinning machine comprising an apparatus for assisting in yarn piecing that guides a worker to a position of a spindle having a yarn break, without requiring additional sensors for detecting the location of the worker.

SUMMARY OF THE INVENTION

[0005] In accordance with an aspect of the present invention, a ring spinning machine including an apparatus for assisting in yarn piecing is provided. The ring spinning machine has a plurality of spindles and a plurality of yarn break detectors provided for the respective spindles. The apparatus for assisting in yarn piecing includes a position detector, at least one guide, and a controller. The position detector detects a location of a worker who is in charge of yarn piecing operation. The guide guides the worker to a position of one of the spindles having a yarn break. The controller controls the guide based on the position of the spindle having the yarn break and the location of the worker detected by the position detector. The position detector includes a state memory and a worker's position determiner. The state memory stores a state of each spindle detected by the yarn break detector associated with the spindle. The state includes a yarn break state and a non-yarn break state. When the state of any of the spindles stored in the state memory is changed from the yarn break state to the non-yarn break state, the worker's position determiner determines that the position of the spindle as the location of the worker.

[0006] 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

[0007] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the embodiments together with the accompanying drawings in which:

FIG. 1 shows an example layout of ring spinning machines comprising an apparatus for assisting in yarn piecing according to a first embodiment of the present invention;

FIG. 2 shows an example structure of the ring spinning machine of FIG. 1;

FIG. 3 shows an example configuration of an information processing device of FIG. 1;

FIG. 4 is a flow chart showing an example operation of the information processing device according to the first embodiment;

FIG. 5 is an explanatory view illustrating an example of determination of a target spindle made by a target determiner of FIG. 2;

FIG. 6 shows an example layout of ring spinning machines comprising an apparatus for assisting in yarn piecing according to a second embodiment of the present invention; and

FIG. 7 is a flow chart showing an example operation of an information processing device according to the second embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0008] The following will describe embodiments of the present invention with reference to the accompanying drawings.

First Embodiment

[0009] FIG. 1 shows an example layout of ring spinning machines comprising an apparatus for assisting in yarn piecing according to a first embodiment of the present invention. The apparatus for assisting in yarn piecing according to the first embodiment is associated with one or more ring spinning machines 10. It is preferable that plural ring spinning machines 10 are arranged in rows in a factory or a place as illustrated in FIG. 1. It should be noted, however, that the present invention can be carried out also in the case where the ring spinning machines 10 are not arranged in rows or where there is only a single ring spinning machine 10.

[0010] The apparatus for assisting in yarn piecing ac-

cording to the first embodiment includes an information processing device 20 and a mobile terminal 30. The information processing device 20 includes an arithmetic unit and a memory. The information processing device 20 may be configured by using a known computer. The information processing device 20 further includes a communicator that transmits/receives data or information to/from devices provided in association with the ring spinning machines 10 and to/from the mobile terminal 30.

[0011] The mobile terminal 30 includes an arithmetic unit and a memory. The mobile terminal 30 may be comprised of a personal mobile computer. The mobile terminal 30 further has a communicator that transmits/receives data or information to/from the information processing device 20. The mobile terminal 30 may be a smart phone or a wearable computer. According to the first embodiment, the mobile terminal 30 corresponds to the guide of the present invention that guides a worker to a position of a spindle having a yarn break.

[0012] FIG. 2 shows an example structure of the ring spinning machine 10 (only one ring spinning machine 10 is shown). The ring spinning machine 10 includes a plurality of spindles 11, a plurality of yarn break sensors 12, and a plurality of yarn break indicator lamps 13. The yarn break sensors 12 correspond to the yarn break detectors of the present invention and are provided for the respective spindles 11. In the first embodiment, the yarn break indicator lamps 13 are also provided for the respective spindles 11.

[0013] Each yarn break sensor 12 acquires information for determining whether its corresponding spindle 11 has a yarn break or not, i.e., whether the spindle 11 is in a yarn break state or in a non-yarn break state. The specific configuration of the yarn break sensors 12 may optionally be designed by a person skilled in the art. For example, the yarn break sensors 12 may be of an optical type or a magnetic type. One example of the magnetic type yarn break sensors is described in Japanese Unexamined Patent Application Publication No. 2014-169511.

[0014] According to the first embodiment, each yarn break indicator lamp 13 is turned on in response to a signal sent from its corresponding yarn break sensor 12. For example, when a yarn break has occurred at any one of the spindles 11, the yarn break is detected by the yarn break sensor 12 associated with the spindle 11, and the yarn break indicator lamp 13 associated with the yarn break sensor 12 is turned on. The yarn break indicator lamp 13 is kept illuminated while the yarn break sensor 12 detects the yarn break in the spindle 11. The yarn break indicator lamp 13 is tuned off when the yarn break sensor 12 detects the spindle 11 does not have a yarn break any longer after any remedy, such as a yarn piecing operation has been performed.

[0015] According to the first embodiment, the spindles 11 are arranged in two rows in the longitudinal direction of each ring spinning machine 10, as illustrated in FIG. 2. One of the two rows of the spindles 11 is disposed in a first spindle line 10a, and the other is disposed in a second spindle line 10b.

[0016] The first spindle line 10a and the second spindle line 10b are disposed facing each other with respect to a specified reference point or line (e.g., a longitudinal centerline of the ring spinning machine 10). Referring to FIG. 2, a worker W in charge of yarn piecing operation is present near the first spindle line 10a. In this case, although the worker W is able to promptly perform yarn piecing operation on a spindle 11a that is disposed in (or belongs to) the first spindle line 10a, the worker W needs to move to the opposite side of the ring spinning machine 10 for performing yarn piecing operation on a spindle 11b arranged in the second spindle line 10b.

[0017] FIG. 3 shows an example configuration of the information processing device 20. The information processing device 20 includes a position detector 21, a target determiner 24, and a controller 25. The position detector 21 includes a state memory 22 and a worker's position determiner 23. The configuration of the position detector 21, the state memory 22, the worker's position determiner 23, the target determiner 24, and the controller 25 is built by the arithmetic unit and the memory of the information processing device 20 that work in a cooperative manner in accordance with programs stored in the memory.

[0018] The position detector 21 is configured to detect a location of the worker W. Specifically, the state memory 22 of the position detector 21 is configured to communicate with the respective yarn break sensors 12 and stores the state of each spindle 11 detected by its corresponding yarn break sensor 12. For example, the detected state, i.e., the state of each spindle 11, may be represented either as a yarn break state or a non-yarn break state, and the state memory 22 stores whether the spindle is in the yarn break state or in the non-yarn break state for each of the spindles 11.

[0019] The worker's position determiner 23 is configured to determine the current location of the worker W. Specifically, when the state of any of the spindles 11 stored in the state memory 22 is changed from the yarn break state to the non-yarn break state, the worker's position determiner 23 determines the position of the spindle 11 as the location of the worker W. For example, if there are plural yarn breaks and the worker performs yarn piecing operation for each of the spindles 11 having the yarn break, the worker's position determiner 23 determines and updates the location of the worker W each time a yarn piecing operation is completed.

[0020] The form or type of the information that indicates the positions of the respective spindles 11 may optionally be designed. For example, a position of a certain spindle 11 may be represented by a set of information that includes a machine identification information, a spindle line identification information, and a spindle identification information. The machine identification information herein refers to the information for identifying a ring spinning machine 10. For example, the machine identification information indicates which one of the ring spinning ma-

chines 10, shown in FIG. 1, the spindle 11 belongs to. The spindle line identification information herein refers to the information for identifying a spindle line of a ring spinning machine 10 in which the spindle 11 is disposed. For example, the spindle line identification information indicates which one of the first and second spindle lines 10a and 10b of the ring spinning machine 10, shown in FIG. 2, the spindle 11 belongs to. The spindle identification information herein refers to the information for identifying the position of the spindle 11 in a spindle line. For example, the spindle identification information is represented by a position of the spindle 11 in the longitudinal direction of the ring spinning machine 10. Alternatively, a number is allocated to each of the spindles 11 that are arranged in the longitudinal direction of the ring spinning machine 10.

[0021] The target determiner 24 is configured to determine the spindle which has a yarn break, i.e., the target spindle, on which the worker W should perform a yarn piecing operation next. According to the first embodiment, the determination of the target spindle is made based on the location of the worker W.

[0022] The controller 25 is configured to control the operation of the mobile terminal 30 based on the location of the worker W and the position of the spindle 11 having a yarn break. For the ease of explanation, the spindle which has a yarn break will hereinafter be referred to as *the yarn break spindle.* For example, the controller 25 identifies and selects one of the yarn break spindles, and sends an instruction to the mobile terminal 30 so as to cause the mobile terminal 30 to output information regarding a path or route to the selected yarn break spindle.

[0023] The following will describe an example of the operation of the ring spinning machine comprising the apparatus for assisting in yarn piecing having the above-described configuration.

[0024] FIG. 4 is a flow chart showing an example operation of the information processing device 20 according to the first embodiment of the present invention. The operation according to this flow chart is triggered by a yarn piecing operation. Specifically, the operation is started with the determination of the location of the worker W by the position detector 21 that is made in response to detecting that a yarn piecing operation has been performed on any of the yarn break spindles (Step S1).

[0025] For example, the location of the worker W is determined as follows. Here, it is assumed that a yarn break has occurred at the spindle 11a of FIG. 2. The yarn break sensor 12 that is associated with the spindle 11a detects the yarn break and then transmits a signal indicating that the spindle 11a has a yarn break (i.e., the spindle 11a is in the yarn break state) to the position detector 21. The position detector 21 receives the signal from the yarn break sensor 12, and then the state memory 22 of the position detector 21 stores the state of the spindle 11a as being in the yarn break state.

[0026] After the worker W completed a yarn piecing operation on the spindle 11a, the yarn break sensor 12 associated with the spindle 11a detects that the spindle 11a does not have the yarn break any longer (i.e., the spindle 11a is now in the non-yarn break state). The yarn break sensor 12 then transmits a signal indicating that the spindle 11a is in the non-yarn break state to the position detector 21. The position detector 21 receives the signal from the yarn break sensor 12 of the spindle 11a, and then the state memory 22 of the position detector 21 stores the state of the spindle 11a as being in the non-yarn break state.

[0027] Thus, the state of the spindle 11a stored in the state memory 22 is changed from the yarn break state to the non-yarn break state. In response to the change in the state of the spindle 11a, the worker's position determiner 23 determines that the worker W is currently at the spindle 11a, as illustrated in FIG. 2. This determination is based on a rationale that the worker W is present at or around the spindle that had a yarn piecing operation at least at the time of and immediately after the yarn piecing operation.

[0028] In the example of FIG. 4, it is assumed that there are other yarn break spindles than the spindle on which the yarn piecing operation has been performed at Step S1. The drawings do not particularly illustrate the case where there is only one yarn break spindle. However, in such case, the operation of FIG. 4 may be terminated.

[0029] After the location of the worker W is determined at Step S1, the target determiner 24 determines a yarn break spindle or a target spindle on which the worker should perform a yarn piecing operation next (Step S2). According to the first embodiment, the target spindle is determined based on the location of the worker W that is determined at Step S1. In the case where there is only one yarn break spindle, the target determiner 24 determines the yarn break spindle as a target spindle. In the case where there are plural yarn break spindles, the target determiner 24 selects one of the yarn break spindles as a target spindle. Although an example of the selection of a target spindle is described below, the criteria for the selection of the target spindle may optionally be determined.

[0030] The following will describe an example of the determination of a target spindle by the target determiner 24 with reference to FIG. 5. FIG. 5 illustrates three ring spinning machines 10 and the worker W who has just completed a yarn piecing operation on a spindle 40. Referring to FIG. 5, there remain four more yarn break spindles 41, 42, 43, and 44 that are in the yarn break state after the yarn piecing operation on the spindle 40.

[0031] First, the target determiner 24 calculates and determines paths from the current location of the worker W to the positions of the respective yarn break spindles 41, 42, 43, and 44. The calculation of a path by the target determiner 24 is made based on the relation among aisles and the positions of the spindles (i.e., the location of the worker W and the positions of the yarn break spindles). The aisle herein refers to a passage or a space through which the worker W can pass along the spindle

lines of the ring spinning machines 10. In the example of FIG. 5, aisles 51, 52, 53, and 54 are provided, and each spindle 11 belongs to one of the aisles 51, 52, 53, and 54. It is to be noted that "a spindle *belongs to* an aisle" herein does not necessarily mean that the spindle is physically disposed in the aisle or the space of the aisle. If the spindle is disposed at a position near any of the aisles where the worker W can readily perform a yarn piecing operation on the spindle, then the spindle is regarded as *belonging* to the aisle.

[0032] Spindles disposed in two facing spindle lines of two neighboring ring spinning machines 10 belong to the same aisle. In the example of FIG. 5, the spindle 40 or the location of the worker W, the yarn break spindle 41, and the yarn break spindle 42 belong to the aisle 52. Spindles in other spindle lines of the same ring spinning machine 10 belong to different aisles. In the example of FIG. 5, the yarn break spindle 41 belongs to the aisle 52, while the yarn break spindle 43 of the same ring spinning machine 10 belongs to the aisle 51.

[0033] If both the current location of the worker W and a yarn break spindle belong to the same aisle, the path may be defined by a single straight line extending along the aisle. In the example of FIG. 5, a path P41 to the yarn break spindle 41 and a path P42 to the yarn break spindle 42 are defined.

[0034] In the case where the location of the worker W and the position of the yarn break spindle belong to different aisles, the path between them may be formed by connecting a line extending along an aisle and a line extending along a different aisle. In the example of FIG. 5, a path P43 from the worker W to the yarn break spindle 43 is a polygonal path that is formed by connecting a line that extends from the location of the worker W to one end of the aisle 52, a line that extends between the aisle 52 and the aisle 51, and a line that extends from one end of the aisle 51 to the yarn break spindle 43. A path P44 may be formed in the same manner as the path P43. However, in the case of the path P44, the length of the line extending between aisles (or the distance between the end or exit of the aisle 52 and the end of the aisle 54) is twice the length of the line between aisles of the path P43 (or the distance between the end or exit of the aisle 52 and the end of the aisle 51).

[0035] The unit of length of a path or a line forming a path may optionally be determined. For example, the length of a path or a line extending along an aisle may be expressed by the number of spindles arranged for the length of the path or the line. Further, the length of a line extending between aisles may be expressed by the number of the ring spinning machines 10 along which the line extends. The length of a path or a line may be converted, for example, by being multiplied by a specified constant.

[0036] According to the present embodiment, the lateral ends of the aisles are opened. Therefore, the combination of the lines forming a path varies depending on which lateral side of the ring spinning machine(s) 10 the line between aisles extends along. That is, a path from the worker W to a certain yarn break spindle may be formed in several patterns. In such case, the shortest path may be selected and determined as the path to the yarn break spindle.

[0037] As described above, the target determiner 24 calculates paths to the respective yarn break spindles and then selects and determines one of the yarn break spindles which has the shortest path among the calculated paths as the target spindle on which a yarn piecing operation is to be performed. In the example of FIG. 5, the yarn break spindle 41 is determined as the target spindle.

[0038] After the target spindle is determined at Step S2, the apparatus for assisting in yarn piecing guides the worker W to the position of the target spindle (Step S3). Specifically, the controller 25 transmits to the mobile terminal 30 the information for guiding the worker W to the yarn break spindle 41. The mobile terminal 30 receives the information from the controller 25 and provides the worker W with the information. The information for guiding the worker W to the target spindle includes, for example, the machine identification information, the spindle line identification information, and the spindle identification information. The mobile terminal 30 outputs such information by displaying them on a display thereof.

[0039] In this way, the worker W is guided to the target spindle for yarn piecing operation. The worker W moves to the position of the target spindle based on and in accordance with the information output by means of the mobile terminal 30. After the worker W has moved to the vicinity of the target spindle, the worker W is able to identify the target spindle by eye by the illumination of the yarn break indicator lamp 13 associated with the target spindle.

[0040] As described above, the apparatus for assisting in yarn piecing according to the first embodiment of the present invention guides the worker W to a position of a yarn break spindle in an optimum manner. Since the location of the worker W is determined based on the detection results of the yarn break sensors 12, the apparatus does not require any additional sensor, such as a motion sensor, for detecting the location of the worker W.

[0041] Further, according to the first embodiment, only the next target spindle needs to be determined. Therefore, in the case of occurrence of yarn breaks at plural spindles, the computational load is reduced, as compared with a configuration which calculates all the possible paths each covering all the yarn break spindles in order to perform yarn piecing operation sequentially on the yarn break spindles.

[0042] Since the location of the worker W is determined by detecting that a yarn piecing operation has been performed on any of the spindles, the accuracy of the determination of the location of the worker W is enhanced. In particular, a configuration employing motion sensors may detect any person other than the worker W in charge of yarn piecing, and such faulty detection of the motion

sensors may disturb the processing and operation. In contrast, the apparatus for assisting in yarn piecing according to the first embodiment reduces such risk.

[0043] Further, the location of the worker W is determined in units of spindles instead of aisles. Therefore, the length of a path from the worker W to a yarn break spindle is calculated and determined more accurately and appropriately. In the example of FIG. 5, if the device locates the location of the worker W in units of the aisles only, determination or selection of the target spindle (i.e., the selection of the yarn break spindle 41 or the yarn break spindle 42) may not be made appropriately when guiding the worker W.

Second Embodiment

[0044] In the first embodiment, the apparatus for assisting in yarn piecing first determines a target spindle on which the worker W should perform a yarn piecing operation next, and guides the worker W to the position of the target spindle. A ring spinning machine comprising an apparatus for assisting in yarn piecing according to a second embodiment differs from that of the first embodiment in that the apparatus guides the worker W based on a different criterion. The following description will describe the difference from the first embodiment.

[0045] FIG. 6 shows an example layout of the ring spinning machines comprising the apparatus for assisting in yarn piecing according to the second embodiment of the present invention. The apparatus for assisting in yarn piecing according to the second embodiment includes an information processing device 20'. The information processing device 20' includes an arithmetic unit and a memory. The information processing device 20' may be configured by using a known computer. The information processing device 20' further includes a communicator that transmits/receives data or information to/from devices provided in association with the ring spinning machine 10, such as the yarn break indicator lamps 13 of FIG. 2.

[0046] In the apparatus for assisting in yarn piecing according to the second embodiment, the yarn break indicator lamps 13 (FIG. 2) provided for the respective spindles 11 correspond to the guide of the present invention.

[0047] FIG. 7 is a flow chart showing an example operation of the information processing device 20' according to the second embodiment of the present invention. The operation according to the flow chart is triggered by a yarn piecing operation. Specifically, the operation is started with the determination of the location of the worker W by the position detector 21 that is made in response to detecting that a yarn piecing operation has been performed on any of the spindles 11 (Step S11), as is the case of Step S1 of the first embodiment (FIG. 4).

[0048] Subsequently, a target determiner 24 determines the target spindle on which yarn piecing operation is to be made (Step S12). Unlike the first embodiment, the target determiner 24 determines a target spindle regardless of the current location of the worker W. For example, the target determiner 24 determines a target spindle based on the density of the yarn break spindles. The density of the yarn break spindles at a selected yarn break spindle may be expressed by a total of inverse numbers of the distances from the selected yarn break spindle to the positions of the other yarn break spindles around the selected yarn break spindle. Alternatively, the density may be expressed by the inverse number of the distance from the position of the selected yarn break spindle to the position of the yarn break spindle that is closest to the yarn break spindle. According to the above determination method, the worker W is guided preferentially to an area having a larger density of the yarn break spindles, resulting in an enhanced working efficiency of the worker W.

[0049] Subsequently, a controller 25 of the information processing device 20' determines or selects a guide to be activated based on the position of the target spindle and the location of the worker W (Step S13). According to the second embodiment, the controller 25 selects one or more yarn break indicator lamps 13 disposed along the path from the location of the worker W to the position of the target spindle.

[0050] Then, the controller 25 causes the selected yarn break indicator lamps 13 to guide the worker W to the position of the target spindle (Step S14). Specifically, the controller 25 transmits instructions for turning on or off the selected yarn break indicator lamps 13. In response to the instructions received from the controller 25, the yarn break indicator lamps 13 guide the worker W to the target spindle by turning on or off according to the received instructions. For example, the yarn break indicator lamps 13 may be caused to blink sequentially in the direction from the location of the worker W toward the position of the target spindle, as described in paragraph [0026] of the Japanese Unexamined Patent Application Publication No. 2015-227520. In this case, the yarn break indicator lamp 13 of the target spindle does not need to blink; the yarn break indicator lamp 13 may be kept illuminated.

[0051] In this way, the worker W is guided to the target spindle. The worker W is able to move to the position of the target spindle by following the direction indicated by the blinking yarn break indicator lamps 13. After the worker W has moved to the vicinity of the target spindle, the worker W is able to find the target spindle by the last blinking yarn break indicator lamp 13 or the illumination of the yarn break indicator lamp 13 that is kept illuminated.

[0052] The first and second embodiments of the present invention may be modified, for example, in the manners described below.

[0053] The configurations of the first and second embodiments or the modifications thereof may be combined. For example, the density of the yarn break spindles and the duration of a yarn break in each of the yarn break spindles may be taken into account in the determination of the target spindle of the first embodiment (i.e., Step

S2 of FIG. 4). Further, the output of the mobile terminal 30 according to the first embodiment may be combined with or replaced by the blinking of the yarn break indicator lamps 13.

[0054] In the second embodiment, in place of or in addition to the density of the yarn break spindles, the duration of the yarn break in each of the yarn break spindles may be taken into account in the determination of the target spindle. For example, a function that is defined by the duration of the yarn break and the lengths of the paths from the worker W to the respective yarn break spindles may be used to select the target spindle. In this case, the position of the yarn break spindle that maximizes or minimizes the value of the function is determined as a target spindle. According to the modification, the yarn break spindles are prevented from being left unattended for a long period of time.

[0055] In the first and second embodiments, the configuration of the hardware components of the computer of the apparatus for assisting in yarn piecing may optionally be modified. For example, the guide of the present invention is not limited to the mobile terminal 30 and the yarn break indicator lamps 13, and includes any type of equipment that can be associated with the ring spinning machine 10 or the aisles. For example, displays or computers having a display may be arranged at specified intervals as the guide of the present invention. In the first embodiment, all the displays may present the information indicating the position of the target spindle at the same time. Alternatively, only the display disposed near the worker W may present such information. In the second embodiment, only the display that is disposed near the worker W may present the information indicating the position of the target spindle.

[0056] The information processing device 20, the information processing device 20', and the mobile terminal 30 may each be configured by a single computer. In that case, the mobile terminal 30 includes the position detector 21, the state memory 22, the worker's position determiner 23, the target determiner 24, and the controller 25. The ring spinning machine 10 is provided with a wireless transmitter that is configured to transmit detection results of the yarn break sensors 12 to the mobile terminal 30. The operation of FIG. 3 may be performed when the mobile terminal 30 receives the detected state of the yarn break sensors 12 from the transmitter.

[0057] In the first and second embodiments, the output of information to guide the worker W to the target spindle is provided by visual presentation that uses a display or illumination of the lamps. However, the output of the information is not limited thereto. For example, an audio presentation, such as voice, may be used for the output of information. In the first embodiment, the mobile terminal 30 may generate and output audio information. Instead of the mobile terminal 30, any other device, such as a speaker associated with the aisles, the ring spinning machines 10, or the information processing device 20 may generate and output audio information. In the second embodiment, the apparatus for assisting in yarn piecing may include a plurality of speakers that are arranged along the aisles, and any of the speakers located near the worker W may generate and output audio information indicating the position of the target spindle. In this case, the yarn break indicator lamps 13 may not be used.

[0058] In the first embodiment, a single mobile terminal 30 is used. However, two or more mobile terminals 30 may be used. For example, the mobile terminals 30 that are identifiable from each other may be allocated to the workers. In this case, the method of identifying the mobile terminal 30 that is to be controlled by the controller 25 may optionally be designed. For example, each worker enters identification information of the mobile terminal 30 of the worker into the information processing device 20 prior to operation start so that the controller 25 can identify the mobile terminal 30 to be controlled and transmit information to the mobile terminal 30 based on the identification information.

[0059] A ring spinning machine (10) that includes an apparatus for assisting in yarn piecing is provided. The apparatus includes a position detector (21), at least one guide (13, 30) that guides a worker (W) to a position of one of the spindles (11, 41, 42, 43, 44) having a yarn break, and a controller (25) that controls the guide (13, 30) based on the position of a spindle (11, 41, 42, 43, 44) having the yarn break and a location of the worker (W). The position detector (21) includes a state memory (22) and a worker's position determiner (23) that, when a state of any of the spindles (11, 41, 42, 43, 44) is changed from a yarn break state to a non-yarn break state, determines that the position of the spindle (11, 41, 42, 43, 44) as the location of the worker (W).

Claims

1. A ring spinning machine (10) comprising an apparatus for assisting in yarn piecing, the ring spinning machine (10) having a plurality of spindles (11, 41, 42, 43, 44) and a plurality of yarn break detectors (12) provided for the respective spindles (11, 41, 42, 43, 44), wherein the apparatus for assisting in yarn piecing comprises:

   a position detector (21) that detects a location of a worker (W) in charge of yarn piecing operation;
   at least one guide (13, 30) that guides the worker (W) to a position of one of the spindles (11, 41, 42, 43, 44) having a yarn break; and
   a controller (25) that controls the at least one guide (13, 30) based on the position of the spindle (11, 41, 42, 43, 44) having the yarn break and the location of the worker (W) detected by the position detector (21), **characterized in that** the position detector (21) includes:

a state memory (22) that stores a state of each spindle (11, 41, 42, 43, 44) detected by the yarn break detector (12) associated with the spindle (11, 41, 42, 43, 44), wherein the state includes a yarn break state and a non-yarn break state, and
a worker's position determiner (23) that, when the state of any of the spindles (11, 41, 42, 43, 44) stored in the state memory (22) is changed from the yarn break state to the non-yarn break state, determines the position of the spindle (11, 41, 42, 43, 44) as the location of the worker (W).

2. The ring spinning machine (10) comprising the apparatus for assisting in yarn piecing according to claim 1, **characterized in that** the apparatus for assisting in yarn piecing includes a target determiner (24) that, when there is a plurality of yarn break spindles (11, 41, 42, 43, 44) having a yarn break, determines a target spindle (11, 41, 42, 43, 44) having a yarn break on which the worker (W) performs a yarn piecing operation next, based on the location of the worker (W) detected by the position detector (21).

3. The ring spinning machine (10) comprising the apparatus for assisting in yarn piecing according to claim 2, **characterized in that**
the target determiner (24) is configured to:

calculate paths from the location of the worker (W) to positions of the respective plurality of spindles (11, 41, 42, 43, 44) having the yarn break, and
determine one of the spindles (11, 41, 42, 43, 44) having the yarn break that has the shortest path among the calculated paths as the target spindle (11, 41, 42, 43, 44).

4. The ring spinning machine (10) comprising the apparatus for assisting in yarn piecing according to any one of claims 1 to 3, **characterized in that**
the position of the spindle (11, 41, 42, 43, 44) having the yarn break is represented by:

a machine identification information for identifying a ring spinning machine (10);
a spindle line identification information for identifying a spindle line (10a, 10b) of a ring spinning machine (10) in which a spindle (11, 41, 42, 43, 44) is disposed; and
a spindle identification information for locating a position of a spindle (11, 41, 42, 43, 44) in a spindle line (10a, 10b).

5. The ring spinning machine (10) comprising the apparatus for assisting in yarn piecing according to any one of claims 1 to 4, **characterized in that**
the at least one guide (13, 30) includes a plurality of guides (13, 30), and
the controller (25) selects one or more of the guides (13, 30) to be activated based on the location of the worker (W).

FIG. 1

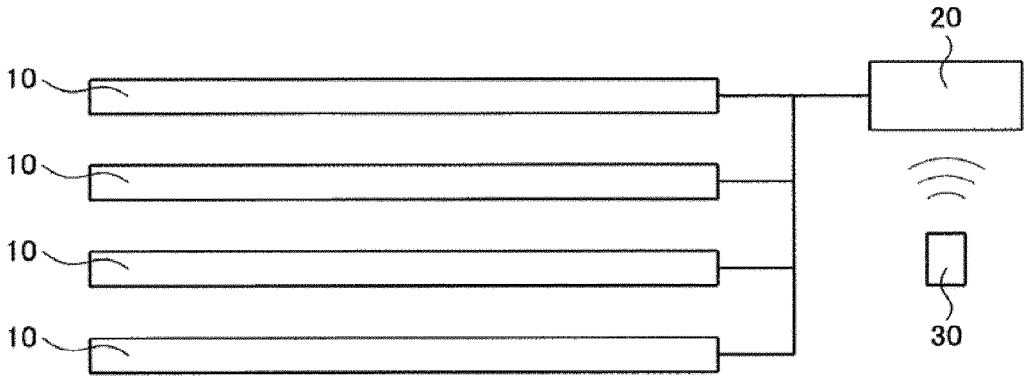


FIG. 2

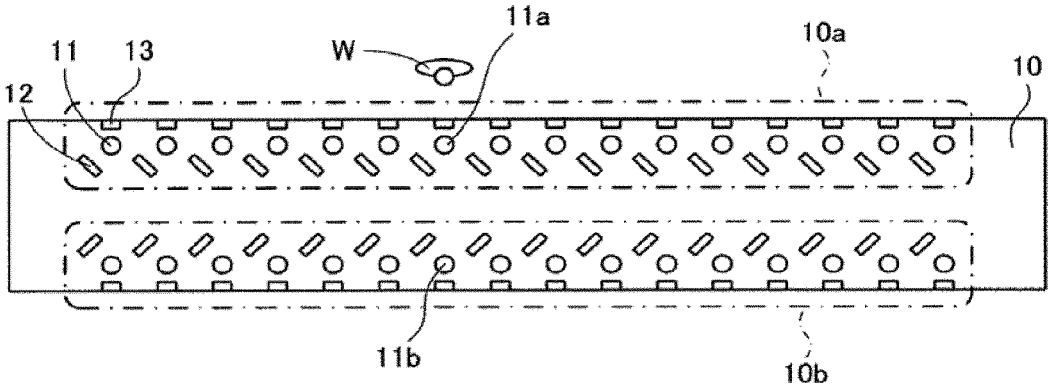


FIG. 3

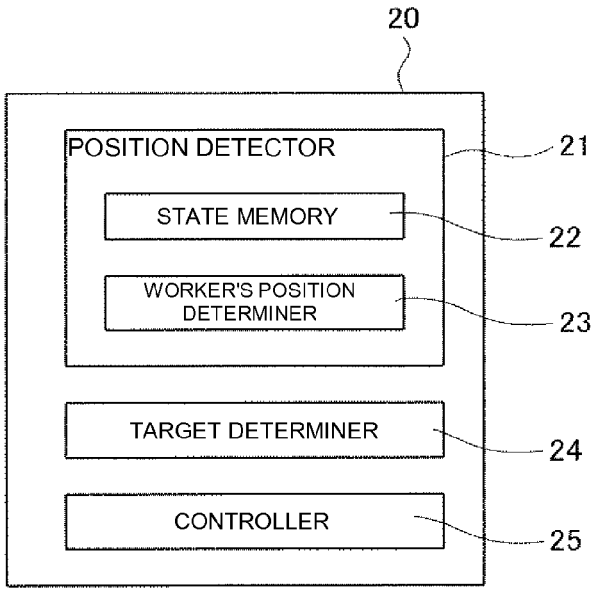


FIG. 4

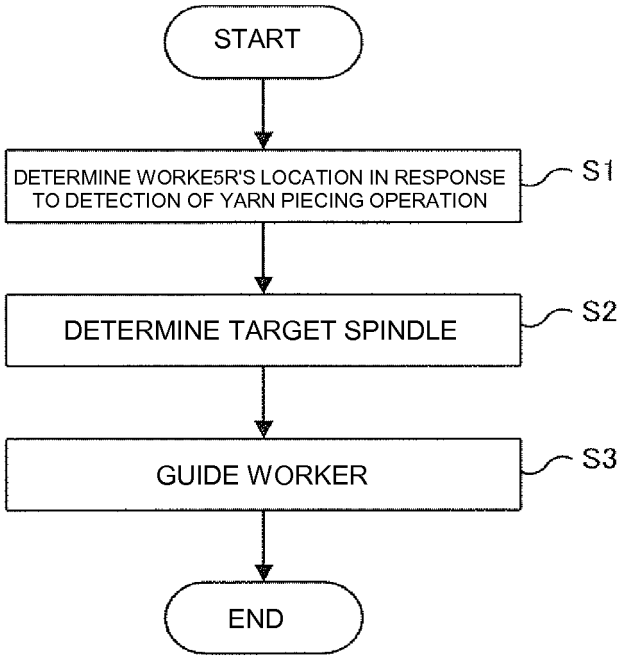

START
DETERMINE WORKE5R'S LOCATION IN RESPONSE TO DETECTION OF YARN PIECING OPERATION
S1
DETERMINE TARGET SPINDLE
S2
GUIDE WORKER
S3
END

FIG. 5

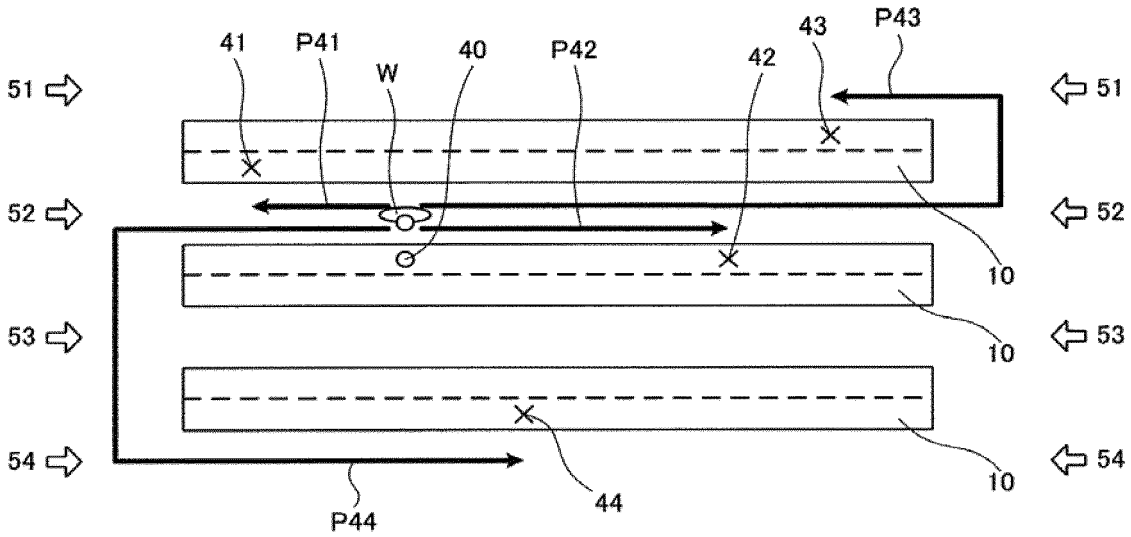

41
P41
W
40
P42
42
43
P43
51
52
53
54
10
44
P44

FIG. 6

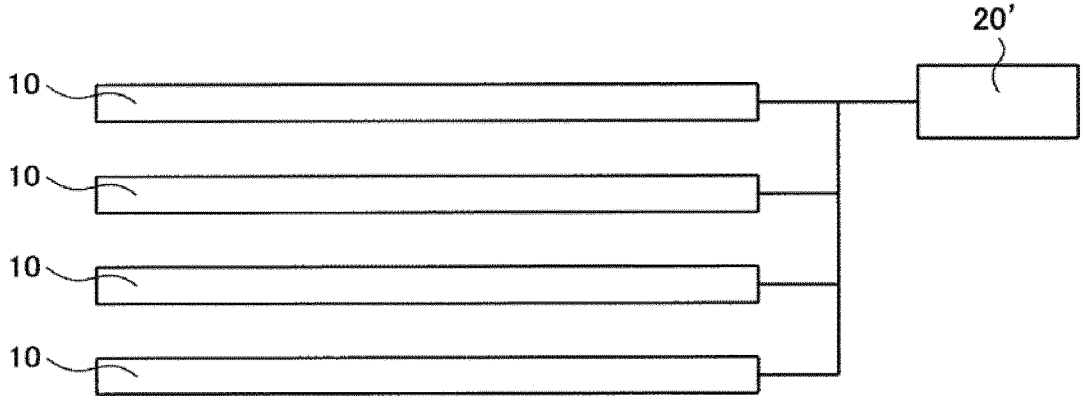
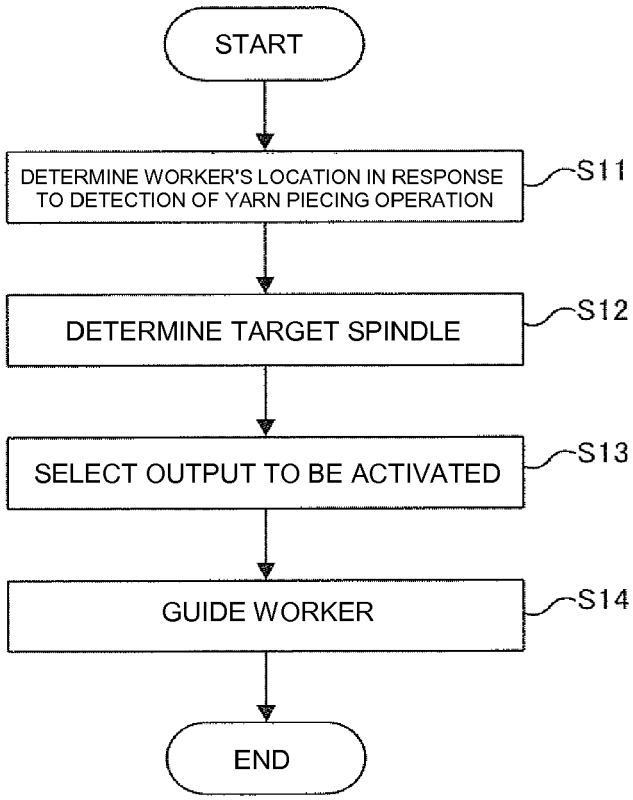

20'
10
10
10
10

FIG. 7


START
DETERMINE WORKER'S LOCATION IN RESPONSE TO DETECTION OF YARN PIECING OPERATION
S11
DETERMINE TARGET SPINDLE
S12
SELECT OUTPUT TO BE ACTIVATED
S13
GUIDE WORKER
S14
END

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EUROPEAN SEARCH REPORT

Application Number
EP 18 16 5396

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 659 082 A2 (MURATA MACHINERY LTD [JP]) 24 May 2006 (2006-05-24) * paragraph [0015] - paragraph [0016] * * figure 4 *	1	INV. D01H15/013
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TECHNICAL FIELDS SEARCHED (IPC)
D01H
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 August 2018	Humbert, Thomas

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06-08-2018

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