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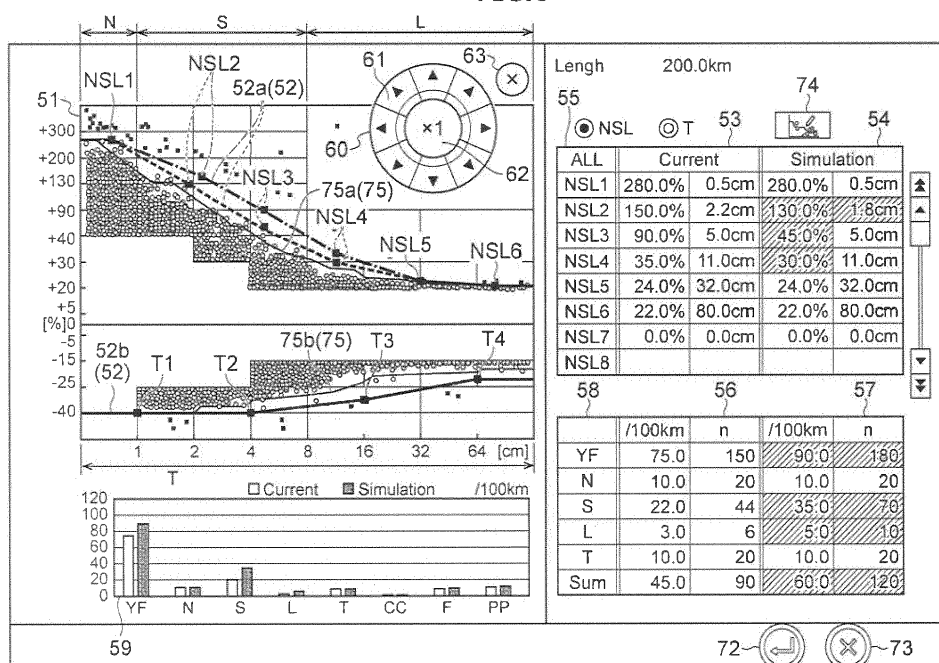
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(54) **CLEARING LIMIT SETTING DEVICE AND YARN WINDING MACHINE**

(57) A main control device includes a touch panel (41) that displays a clearing limit (52) in a two-dimensional field (51), and a processing section (42). The processing section (42), when at least one first set-point is selected among one or more first set-points through which the clearing limit (52) passes (e.g., set-points NSL1 to NSL6 and T1 to T4) and when at least one second

set-point (e.g., set-points NSL2 to NSL4) is input as a movement destination of the selected at least one first set-point, generates a clearing limit (52) that passes through the input at least one second set-point instead of the selected at least one first set-point, and causes the touch panel (41) to display the newly generated clearing limit (52).

FIG.6



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a clearing limit setting device and a yarn winding machine.

2. Description of the Related Art

[0002] A control device of some yarn winding machines has a function to display, in a two-dimensional field having the length and the thickness of yarn defects as coordinate axes, a clearing limit that is a boundary line that defines whether to remove a yarn defect (for example, see Japanese Patent No. 5680653). The yarn defect as used herein includes yarn defects that must be removed and yarn defects that need not be removed and can remain in the yarn.

SUMMARY OF THE INVENTION

[0003] When setting the clearing limit, numerical values of coordinates (that is, the length and the thickness of the yarn defect) of a point through which the clearing limit passes are input.

[0004] However, there are instances in which the clearing limit does not have a desired shape. If this happens, it is necessary to input the numerical values again and again.

[0005] One object of the present invention is to provide a clearing limit setting device and a yarn winding machine in which a clearing limit can be set easily and suitably.

[0006] This object is achieved by a clearing limit setting device according to claim 1, and by a yarn winding machine according to claim 15.

[0007] According to one aspect of the present invention, a clearing limit setting device includes a display section that displays, in a two-dimensional field constituted by a length and a thickness of a yarn defect as coordinate axes, a clearing limit that is a boundary line that defines whether to remove a yarn defect from a yarn; and a processing section that, when at least one first set-point is selected among a plurality of the first set-points through which the clearing limit passes and at least one second set-point is input as a movement destination of the selected at least one first set-point, generates a clearing limit that passes through the input at least one second set-point instead of the selected at least one first set-point, and causes the display section to display the newly generated clearing limit.

[0008] In the above clearing limit setting device, by selecting the at least one first set-point among the first set-points through which the clearing limit passes and inputting the at least one second set-point as the movement destination of the selected at least one first set-point, a new clearing limit that passes through the input at least

one second set-point can be generated. Thus, in the above clearing limit setting device, the clearing limit can be set (changed) easily and suitably.

[0009] In the above clearing limit setting device, the processing section can cause the display section to simultaneously display the first set-points and the clearing limit that passes through the first set-points, and the at least one second set-point and the clearing limit that passes through the at least one second set-point. As a result, the operator can easily grasp the first set-points and the second set-points that form the basis of the generation of the clearing limit.

[0010] The above clearing limit setting device can include a first input unit that accepts selection of the at least one first set-point, and a second input unit that accepts input of the at least one second set-point. As a result, the operator can easily and suitably set the clearing limit.

[0011] In the above clearing limit setting device, the first input unit can be the two-dimensional field displayed on the display section. As a result, the operator can easily select the first set-point that should be changed.

[0012] In the above clearing limit setting device, the display section can display a plurality of buttons that respectively correspond to the first set-points, and the first input unit can be the buttons displayed on the display section. As a result, the operator can easily select the first set-point that should be changed in a portion in which the clearing limit is displayed in detail, for example.

[0013] In the above clearing limit setting device, the display section can display an operation area that includes a plurality of movement direction setting buttons that shows movement directions and accepts selection of the movement directions, and the second input unit can be the operation area displayed on the display section. As a result, the operator can intuitively grasp the movement direction of the second set-point with respect to the first set-point that should be changed.

[0014] The above clearing limit setting device can include a third input unit that accepts addition of at least one third set-point when the display section displays the clearing limit that passes through the first set-points. The processing section can generate the clearing limit that passes through the first set-points and the at least one third set-point added by the third input unit and cause the display section to display the newly generated clearing limit. As a result, the operator can partially change the clearing limit.

[0015] In the above clearing limit setting device, the third input unit can be the two-dimensional field displayed on the display section. As a result, the operator can easily input the third set-point that should be added.

[0016] The above clearing limit setting device can include a fourth input unit that accepts deletion of at least one first set-point when the display section displays the clearing limit that passes through the first set-points. The processing section can generate the clearing limit that passes through the first set-points other than the at least one first set-point deleted by the fourth input unit and

cause the display section to display the newly generated clearing limit. As a result, the operator can partially change the clearing limit.

[0017] In the above clearing limit setting device, the fourth input unit can be the two-dimensional field displayed on the display section. As a result, the operator can easily select the first set-point that should be deleted.

[0018] In the above clearing limit setting device, the display section can display a plurality of buttons that respectively correspond to the first set-points, and the fourth input unit can be the buttons displayed on the display section. As a result, the operator can easily select the first set-point that should be deleted in a portion in which the clearing limit is displayed in detail, for example.

[0019] The above clearing limit setting device can include a storage section that stores therein yarn defect data containing the length and the thickness of each of a plurality of yarn defects. The processing section, when newly generating the clearing limit with respect to the currently set clearing limit, can calculate a first yarn processing result by using the yarn defect data and the currently set clearing limit and calculate a second yarn processing result by using the yarn defect data and the newly generated clearing limit, and can cause the display section to display the calculated first yarn processing result and the second yarn processing result. As a result, the operator can compare the first yarn processing result and the second yarn processing result, and can evaluate each of the currently set clearing limit and the newly generated clearing limit.

[0020] The above clearing limit setting device can include a storage section that stores therein yarn defect data containing the length and the thickness of each of a plurality of yarn defects. The processing section can generate a guideline by using the yarn defect data, and can cause the display section to display the generated guideline along with dots that represent the yarn defects. As a result, while looking at the guideline, the operator can touch somewhere in the two-dimensional field to input the first set-point.

[0021] According to another aspect of the present invention, a yarn winding machine includes a plurality of yarn winding units each including a yarn supplying section that supplies a yarn; a winding section that winds the yarn to form a package; and a yarn monitoring section that monitors the yarn between the yarn supplying section and the winding section to detect a yarn defect; and a clearing limit setting device as mentioned above.

[0022] Because the above yarn winding machine includes the above-mentioned clearing limit setting device, the yarn defect can be removed suitably.

[0023] According to the present invention, the clearing limit setting device and the yarn winding machine in which the clearing limit can be set easily and suitably can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

FIG. 1 is a block diagram showing a configuration of a yarn winding machine according to an embodiment of the present invention.

FIG. 2 is a block diagram showing a configuration of a yarn winding unit shown in FIG. 1.

FIG. 3 is a block diagram showing a configuration of a main control device shown in FIG. 1.

FIG. 4 is a diagram showing an example of a screen displayed on a touch panel shown in FIG. 1.

FIG. 5 is a diagram showing another example of a screen displayed on the touch panel shown in FIG. 1.

FIG. 6 is a diagram showing still another example of a screen displayed on the touch panel shown in FIG. 1.

FIG. 7 is a diagram showing still another example of a screen displayed on the touch panel shown in FIG. 1.

FIG. 8 is a diagram showing an example of generation of a clearing limit.

FIG. 9 is a diagram showing another example of generation of the clearing limit.

FIG. 10 is a diagram showing still another example of generation of the clearing limit.

FIG. 11 is a diagram showing still another example of generation of the clearing limit.

FIG. 12 is a diagram showing still another example of generation of the clearing limit.

FIG. 13A is a diagram showing an example of selection of a set-point of the clearing limit.

FIG. 13B is a diagram showing another example of selection of a set-point of the clearing limit.

FIG. 14A is a diagram showing still another example of selection of a set-point of the clearing limit.

FIG. 14B is a diagram showing still another example of selection of a set-point of the clearing limit.

FIG. 15 is a diagram showing an example of addition of a set-point of the clearing limit.

FIG. 16 is a diagram showing an example of deletion of a set-point of the clearing limit.

DETAILED DESCRIPTION

[0025] Exemplary embodiments of the present invention are explained below in detail with reference to the accompanying drawings. Identical components or corresponding components are indicated by the same reference symbols in the drawings and redundant explanation thereof is omitted.

[0026] As shown in FIG. 1, a yarn winding machine 1 includes a plurality of yarn winding units 2, a plurality of unit control devices 3, and a main control device (clearing limit setting device) 4. The yarn winding machine 1 is, for example, an automatic winder, an air spinning machine (air jet spinning machine), an open-end spinning machine

(rotor spinning machine), a ring spinning machine, and the like. The yarn winding units 2 are arranged side-by-side. Each of the yarn winding units 2 forms a package by winding a yarn. One unit control device 3 is arranged for a plurality of the yarn winding units 2. This one unit control device 3 controls the operation of all the yarn winding units 2 under control thereof. The main control device 4 communicates with the unit control devices 3 and controls the operation of the entire yarn winding machine 1. Note that, one unit control device 3 can be arranged per yarn winding unit 2.

[0027] As shown in FIG. 2, the yarn winding unit 2 includes a yarn supplying section 21, a yarn monitoring section 22, and a winding section 24. In a configuration in which the yarn winding machine 1 is an automatic winder, the yarn winding unit 2 further includes a yarn joining section 23. Also, in a configuration in which the yarn winding machine 1 is an automatic winder, the yarn winding unit 2 can further include a tension applying device that applies tension on the yarn and a tension sensor that measures the tension applied on the yarn. In a configuration in which the yarn winding machine 1 is an air spinning machine, the yarn winding unit 2 can include at least one among a tension sensor that measures the tension applied on the yarn, a yarn accumulating device that accumulates the yarn, and a waxing device that applies wax to the yarn. In a configuration in which the yarn winding machine 1 is an air spinning machine, it is preferable that the yarn joining section 23 is arranged in a yarn joining cart that can travel with respect to a plurality of the yarn winding units 2.

[0028] The yarn supplying section 21 supplies the yarn. In a configuration in which the yarn winding machine 1 is an automatic winder, the yarn supplying section 21 is configured as a bobbin supporting device that supports a yarn supplying bobbin. In a configuration in which the yarn winding machine 1 is an air spinning machine, the yarn supplying section 21 is configured as a drafting device that drafts a fiber bundle and an air spinning device that twists the drafted fiber bundle by the action of a swirling air current and forms the yarn.

[0029] The yarn monitoring section 22 monitors the yarn between the yarn supplying section 21 and the winding section 24 to detect a yarn defect. The yarn defect is an abnormal portion of the yarn that differs from a normal portion (a portion that is in a normal state) of the yarn. The yarn defect as used herein includes yarn defects that must be removed and yarn defects that need not be removed and can remain in the yarn. The yarn monitoring section 22 includes a detecting device 22a and a control device 22b. The detecting device 22a is an optical sensor that detects a temporal variation in the thickness of the yarn based on a change in a received light amount when light is emitted on the yarn, an electrostatic capacitance sensor that detects a temporal variation in the thickness of the yarn based on a change in an electrostatic capacitance when the yarn is passed through an electric field, and the like. The thickness of the yarn means a diameter

of the yarn. Alternatively, the thickness of the yarn means a fiber amount of the yarn. The detecting device 22a outputs to the control device 22b waveform data that indicates the temporal variation in the thickness of the yarn.

The control device 22b calculates, for each of the yarn defects contained in the yarn, by using the waveform data, yarn defect data, which includes the length and the thickness of the yarn defect, and outputs the yarn defect data to the unit control device 3. When the unit control device 3 determines, from the yarn defect data and a later-explained clearing limit 52, that the yarn defect must be removed, the yarn is cut by a cutter arranged in the yarn winding unit 2, for example. In a configuration in which the yarn winding machine 1 is an air spinning machine, the yarn is automatically cut when the air spinning device stops the formation of the yarn. In addition, the yarn monitoring section 22 can detect a foreign substance contained in the yarn. In addition, the yarn monitoring section 22 can detect a yarn breakage. Moreover, the control device 22b can determine whether the yarn defect, which is detected by using the yarn defect data and the later-explained clearing limit 52, should be removed, and cut the yarn with a cutter arranged in the yarn monitoring section 22. The yarn defect data is transmitted to the main control device 4.

[0030] After the yarn is cut to remove the yarn defect detected by the yarn monitoring section 22, or when the yarn monitoring section 22 detects the yarn breakage, the yarn joining section 23 performs a yarn joining operation to join the yarn from the yarn supplying section 21 and the yarn from the winding section 24. The yarn joining section 23 can be a splicer that uses compressed air, a piecer that uses a seed yarn, a knotter that joins the yarns mechanically, and the like. The yarn joining section 23 joins the yarns guided thereto. It is preferable that a first yarn catching / guiding device and a second yarn catching / guiding device are arranged near the yarn joining section 23. The first yarn catching / guiding device catches the yarn from the yarn supplying section 21 by a suction action and guides the caught yarn to the yarn joining section 23. The second yarn catching / guiding device catches the yarn from the winding section 24 by a suction action and guides the caught yarn to the yarn joining section 23.

[0031] The winding section 24 forms a package by winding the yarn around a bobbin. The winding section 24 includes a cradle arm, a winding drum, and a traversing mechanism. The cradle arm rotatably supports the package. The winding drum can contact a surface of the package supported by the cradle arm and causes the package to rotate. The traversing mechanism traverses the yarn at a predetermined width to the rotating package. It is preferable that the traversing mechanism is configured as a traversing groove formed in the winding drum. The winding section 24 can have a configuration in which a motor rotationally drives the package directly. When such a configuration is employed, it is preferable that the winding section 24 includes, instead of the winding drum, a touch roller that can contact a surface of the package,

and includes as the traversing mechanism a traversing member (e.g., a traversing arm) that is a separate member from the touch roller.

[0032] As shown in FIG. 3, the main control device 4 includes a touch panel (display section) 41, a processing section 42, and a storage section 43. The touch panel 41 displays various information for an operator and receives input of various information from the operator. The processing section 42 acquires the yarn defect data output by the yarn monitoring section 22 of each of the yarn winding units 2. The processing section 42 stores in the storage section 43 separately for each of the yarn winding units 2 the acquired yarn defect data by associating with information indicative of whether the yarn defect is removed or left as is. Alternatively, the processing section 42 can store in the storage section 43 in a mass the yarn defect data acquired from all the yarn winding units 2 by respectively associating with information indicative of whether the yarn defect is removed or left as is. Alternatively, the processing section 42 can store in the storage section 43 in a mass for each of the yarn winding units 2 of the same lot (e.g., same yarn type, same winding condition, same spinning condition, and the like) the acquired yarn defect data by associating with information indicative of whether the yarn defect is removed or left as is. The processing section 42 and the storage section 43 are physically constituted by a CPU (Central Processing Unit), a ROM (Read Only Memory), a RAM (Random Access Memory), and the like.

[0033] The processing section 42 generates a clearing limit and causes the touch panel 41 to display a two-dimensional field and the clearing limit. FIGS. 4 to 7 are drawings that show examples of screens displayed on the touch panel 41. As shown in FIGS. 4 to 7, a two-dimensional field 51 is a coordinate system that shows a matrix of the length and the thickness of the yarn defects. In the figure, the length of the yarn defect is plotted on the horizontal axis and the thickness of the yarn defect (in proportion to the reference yarn thickness) is plotted on the vertical axis. The clearing limit 52 is a boundary line in the two-dimensional field 51 that defines whether the yarn defect should be removed. In other words, the clearing limit 52 is a threshold value set to determine whether the detected yarn defect should be removed or left as is in the yarn. As the clearing limit 52, a clearing limit (first clearing limit) 52a corresponding to nep N, short S, and long L for thick yarn defects and a clearing limit (second clearing limit) 52b corresponding to thin T for thin yarn defects are set. The processing section 42 causes each of the unit control devices 3 to control the operation of the corresponding yarn winding unit 2 so that a yarn defect having a value within an area on a reference yarn thickness side (a side of the horizontal axis where the thickness of the yarn defect is 0%) with respect to the clearing limit 52 is not removed, and a yarn defect having a value within an area opposite to the area on the reference yarn thickness side with respect to the clearing limit 52 is removed.

[0034] The processing section 42 determines a position of the yarn defect on the two-dimensional field 51 based on the yarn defect data stored in the storage section 43, and causes the touch panel 41 to display one yarn defect as one dot. In the present example, the processing section 42 causes to be displayed in the two-dimensional field 51 the yarn defects remaining in the yarn with white round dots and the yarn defects removed from the yarn with black square dots. Furthermore, at any given time point, only a predetermined number of dots that indicate yarn defects of the immediate past are displayed on the touch panel 41. However, all the dots that indicate the yarn defects up to the current time point can be displayed on the touch panel 41 without limiting the number thereof.

[0035] The processing section 42 causes the touch panel 41 to display a current setting values column 53. In the current setting values column 53, setting information about a current clearing limit 52 (currently set clearing limit 52) is displayed. In the present example, in the current setting values column 53 are shown the respective coordinates (i.e., the length and the thickness of the yarn defect) of a plurality of set-points NSL1 to NSL6 located on the current clearing limit 52a.

[0036] The processing section 42 causes the touch panel 41 to display a simulation setting values column 54. In the simulation setting values column 54, setting information about a temporary clearing limit 52 (a newly generated clearing limit 52) is displayed (details will be explained later). In the present example, in the simulation setting values column 54 are shown the respective coordinates (i.e., the length and the thickness of the yarn defect) of a plurality of the set-points NSL1 to NSL6 located on the temporary clearing limit 52a.

[0037] A left side portion of the current setting values column 53 and the simulation setting values column 54 in which the set-points NSL1 to NSL6 are shown is configured as buttons 55. In this manner, the processing section 42 causes the touch panel 41 to display one button 55 corresponding to each of the set-points NSL1 to NSL6. The display of the current setting values column 53 and the simulation setting values column 54 can be switched to a display in which coordinates of a plurality of set-points T1 to T4 located on the clearing limit 52b are displayed. In that case, the processing section 42 causes the touch panel 41 to display one button 55 corresponding to each of the set-points T1 to T4.

[0038] The processing section 42 causes the touch panel 41 to display a current result column 56. As a yarn processing result obtained with the current clearing limit 52, a total removal number (n) of the yarn defects and a removal number (/100 kilometers (km)) of the yarn defects per unit length (100 km in the present embodiment) are displayed for each type of the yarn defects in the current result column 56. The total removal number (n) of the yarn defects shown in the current result column 56 is number of the yarn defects that are actually removed. The total removal number (n) of the yarn defects shown

in the current result column 56 is equivalent to the number of yarn defects having a value that falls in an area opposite to the area on the reference yarn thickness side with respect to the current clearing limit 52. Alternatively, a removal number of the yarn defects when the total removal number (n) of the yarn defects per unit time (e.g., one hour) can be displayed in the current result column 56.

[0039] The processing section 42 causes the touch panel 41 to display a simulation result column 57. As a yarn processing result obtained with the temporary clearing limit 52, a total removal number (n) of the yarn defects and a removal number (/100km) of the yarn defects per unit length (100 km in the present embodiment) are displayed for each type of the yarn defects in the simulation result column 57. The total removal number (n) of the yarn defects shown in the simulation result column 57 is a predicted value estimated based on number of the yarn defects that are actually removed. The total removal number (n) of the yarn defects shown in the simulation result column 57 is equivalent to the number of yarn defects having a value that falls in an area opposite to the area on the reference yarn thickness side with respect to the temporary clearing limit 52. Alternatively, a removal number of the yarn defects when the total removal number (n) of the yarn defects per unit time (e.g., one hour) can be displayed in the simulation result column 57.

[0040] A left side portion of the current result column 56 and the simulation result column 57 is configured as buttons 58. N, S, L, T shown in the left side portion respectively represent nep N, short S, long L, and thin T. Sum represents the total of nep N, short S, long L, and thin T. YF represents the total of Sum and channels other than nep N, short S, long L, and thin T (e.g., F representing mixing of foreign substance (color mixing), C representing different count (yarn thickness), and the like).

[0041] The processing section 42 causes the touch panel 41 to display a graph column 59. The removal number (/100km) of the yarn defects shown in the current result column 56, the removal number (/100km) of the yarn defects shown in the simulation result column 57 are displayed for each type of the yarn defects in the graph column 59 in a graph form. The display of the graph column 59 can be switched to a display in which the total removal number (n) of the yarn defects shown in the current result column 56 and the total removal number (n) of the yarn defects shown in the simulation result column 57 are displayed for each type of the yarn defects in a graph form.

[0042] One example of generation of the clearing limit 52 by the processing section 42 is explained below. When winding of the yarn is started in the yarn winding machine 1, the processing section 42 generates the clearing limit 52, for example, based on the past setting and the like. The generated clearing limit 52 is displayed, as shown in FIG. 4, as the current clearing limit 52 in the two-dimensional field 51. In the yarn winding machine 1, the yarn defects are removed or not removed based on the

current clearing limit 52, and the yarn defect data is generated. The generated yarn defect data is stored in the storage section 43, and, as shown in FIG. 5, displayed as dots (scatter plot) in the two-dimensional field 51. At this time, the yarn processing result obtained with the current clearing limit 52 is displayed as numerical values in the current result column 56, and the yarn processing result obtained with the current clearing limit 52 is displayed in a graph form (e.g., bar graph) in the graph column 59. Alternatively, in the main control device 4, it is possible that the processing section 42 generates the clearing limit 52 that passes through a plurality of the set-points corresponding to a position touched by the operator in the two-dimensional field 51, and the touch panel 41 displays the newly generated clearing limit 52.

[0043] When the operator starts a clearing simulation in the main control device 4, as shown in FIG. 5, setting information about the temporary clearing limit 52 is displayed in the simulation setting values column 54. Also, the yarn processing result obtained with the temporary clearing limit 52 is displayed as numerical values in the simulation result column 57, and the yarn processing result obtained with the temporary clearing limit 52 is displayed in a graph form (e.g., bar graph) in the graph column 59. At this time point, because the temporary clearing limit 52 is the same as the current clearing limit 52, the setting information and the like about the current setting values column 53 and the simulation setting values column 54 are same. Note that, it is preferable to perform the clearing simulation after a winding length of the yarn has reached a certain length (e.g., 100 km) by using the yarn processing result at that time point from a view point of improving the accuracy. If the clearing simulation is started while the winding length of the yarn has not reached the certain length, as shown in FIG. 4, an attention mark 71 is displayed on the touch panel 41.

[0044] When the clearing simulation is started, the processing section 42 generates a guideline 75 by using the yarn defect data of the yarn defects that are not removed from the yarn. The guideline 75, as shown in FIG. 5, is generated so as to follow an outer edge of a distribution pattern of the white round dots (corresponding to the yarn defects that are not removed from the yarn), and displayed in the two-dimensional field 51. In the present example, a guideline (first guideline) 75a corresponding to nep N, short S, and long L (corresponding to the thick yarn defects) and a guideline (second guideline) 75b corresponding to thin T (corresponding to the thin yarn defects) are displayed in the two-dimensional field 51. Alternatively, a plurality of each of the guidelines 75a and 75b can be generated depending on a distribution density of the white round dots, and the generated guidelines 75a and 75b can be displayed in the two-dimensional field 51.

[0045] When the operator operates (presses, physically touches, and the like) a point in the two-dimensional field 51 corresponding to the set-point NSL2 for example, the set-point NSL2 is selected as a movement planned

set-point, and, as shown in FIG. 6, an operation area 60 is displayed on the touch panel 41. Note that, even when the operator operates the button 55 corresponding to the set-point NSL2, for example (e.g., even when an area where the set-point NSL2 has been displayed is operated), the set-point NSL2 is selected as the movement planned set-point. In this manner, in the main control device 4, when the clearing limit 52 that has been generated so as to pass through a plurality of first set-points (current set-points NSL1 to NSL6 and T1 to T4) is displayed on the touch panel 41, the two-dimensional field 51 and the buttons 55 function as a first input unit for selecting at least one of the first set-points (current set-point NSL2).

[0046] The operation area 60 includes movement direction setting buttons 61, a movement distance changing button 62, and a display end button 63. The movement direction setting buttons 61 shows a plurality of candidate movement directions for the movement planned set-point and are operated when setting the movement direction of the movement planned set-point. In the present example, the movement direction setting buttons 61 are arranged at every 45 degrees around the movement distance changing button 62. The movement direction setting buttons 61 correspond clockwise to top, top right, right, bottom right, bottom, bottom left, left, and top left movement directions. The movement distance changing button 62 is used to change the amount (movement distance) by which the selected movement planned set-point is to be moved when the movement direction setting button 61 is operated once. For example, each time the movement distance changing button 62 is operated, the processing section 42 changes the distance by $\times 1$ (movement distance is 1 time of a reference value), $\times 10$ (movement distance is 10 times of the reference value), $\times 100$ (movement distance is 100 times of the reference value). The display end button 63 is used to end the display of the operation area 60 on the touch panel 41. That is, the processing section 42 causes the touch panel 41 to display the operation area 60 when the movement planned set-point is selected; however, when the display end button 63 is operated, the display of the operation area 60 is ended and the selection of the movement planned set-point is cancelled.

[0047] In a state in which the set-point NSL2 has been selected as the movement planned set-point, when the operator operates the movement direction setting button 61 that corresponds to the movement direction "bottom left", for example, as a movement destination of the current set-point NSL2, a temporary set-point NSL2 (set-point NSL2 on the clearing limit 52a shown with a broken line in FIG. 6) is displayed in the two-dimensional field 51. In this manner, in the main control device 4, the operation area 60 functions as a second input unit for inputting at least one second set-point (temporary set-point NSL2) as the movement destination of the at least one first set-point (current set-point NSL2) selected by using one of the two-dimensional field 51 or the buttons 55.

[0048] Similarly, in a state in which the set-point NSL3

has been selected as the movement planned set-point, when the operator operates the movement direction setting button 61 that corresponds to the movement direction "bottom", for example, as a movement destination of the current set-point NSL3, a temporary set-point NSL3 (set-point NSL3 on the clearing limit 52a shown with the broken line in FIG. 6) is displayed in the two-dimensional field 51. Similarly, in a state in which the set-point NSL4 has been selected as the movement planned set-point, when the operator operates the movement direction setting button 61 that corresponds to the movement direction "bottom", for example, as a movement destination of the current set-point NSL4, a temporary set-point NSL4 (set-point NSL4 on the clearing limit 52a shown with the broken line in FIG. 6) is displayed in the two-dimensional field 51. Note that, it is possible to select multiple set-points NSL2, NSL3, and NSL4 at the same time as the movement planned set-point, thereby setting multiple temporary set-points NSL2, NSL3, and NSL4 at the same time as the movement destinations. When multiple set-points are selected and set, a positional relationship of the temporary set-points NSL2, NSL3, and NSL4 is maintained to the same positional relationship of the current set-points NSL2, NSL3, and NSL4. That is, the set-points NSL2, NSL3, and NSL4 are subjected to parallel movement.

[0049] When a plurality of the temporary set-points NSL2, NSL3, and NSL4 are set, the processing section 42 generates the temporary clearing limit 52 (clearing limit 52a shown with the broken line in FIG. 6) that passes through the current set-points NSL1, NSL5, and NSL6 and the temporary set-points NSL2, NSL3, and NSL4, and causes the touch panel 41 to display the generated temporary clearing limit 52. In this manner, when the processing section 42 generates the temporary clearing limit 52 corresponding to the current clearing limit 52, the processing section 42 causes the touch panel 41 to display both the current clearing limit 52 and the temporary clearing limit 52. Also, the processing section 42 calculates the yarn processing result by using the temporary clearing limit 52. The obtained yarn processing result is displayed as numerical values in the simulation result column 57 and displayed in a graph form in the graph column 59.

[0050] Note that, as shown in FIG. 6, in the two-dimensional field 51, by changing the display contents (e.g., different type, thickness, color, and the like of line) of a portion in which the current clearing limit 52 and the temporary clearing limit 52 do not match with each other, it is possible to cause the operator to recognize the non-matching portion. Moreover, by changing the display contents (e.g., color of the character, shape of the character, background color, and the like) of a numerical value that has been changed in the simulation setting values column 54 and the simulation result column 57, it is possible to cause the operator to recognize the changed numerical value.

[0051] In a state in which the current clearing limit 52

and the temporary clearing limit 52 have been displayed in the two-dimensional field 51, when the operator operates a confirm button 72 displayed on the touch panel 41, as shown in FIG. 7, the temporary clearing limit 52 is set newly (i.e., the current clearing limit 52 is replaced with the temporary clearing limit 52). As a result, the processing section 42 reflects in the current setting values column 53 the setting information displayed in the simulation setting values column 54. Also, the processing section 42 reflects in the current result column 56 the yarn processing result that was displayed as a numerical value in the simulation result column 57. Also, the yarn processing result that was displayed in the graph form in the graph column 59 is changed based on the yarn processing result that was displayed as the numerical values in the current result column 56 and the simulation result column 57.

[0052] On the other hand, in a state in which the current clearing limit 52 and the temporary clearing limit 52 have been displayed in the two-dimensional field 51, when the operator operates a cancel button 73 displayed on the touch panel 41, the temporary clearing limit 52 is cancelled, and the setting of the current clearing limit 52 is maintained. Note that, when the operator operates the display end button 63 displayed in the operation area 60, the display of the operation area 60 is ended and the selection of the movement planned set-point is cancelled. Moreover, when the operator operates the button 55 corresponding to the movement planned set-point, the selection of the movement planned set-point is cancelled. However, in neither case that the selection of the movement planned set-point is cancelled, the temporary clearing limit 52 is not cancelled.

[0053] A concrete example of generation of the clearing limit 52 by the processing section 42 is explained below. As shown in FIG. 8, when a set-point NSL2 representing the length 1.0 centimeter (cm) and the thickness 250% of a yarn defect is changed to a set-point NSL2 representing the length 3.0 cm and the thickness 250% of a yarn defect, the processing section 42 generates the clearing limit 52 by connecting the set-points NSL1 to NSL5 in the order of the lengths of the yarn defects. In this case, as shown in FIG. 9, the processing section 42 connects the set-points NSL1 to NSL5 in the order of the set-point NSL1, the set-point NSL3, the set-point NSL2, the set-point NSL4, and the set-point NSL5 thereby generating the temporary (new) clearing limit 52. In this state, when the operator operates the confirm button 72 (see FIG. 7), as shown in FIG. 10, the titles of the set-points NSL1 to NSL5 are changed so that the set points have the titles that are in the order of lengths of the yarn defects. That is, in the column that shows the length and the thickness of the yarn defect per set-point, the titles of the set-points NSL1 to NSL5 are changed so that the titles are in the order of lengths of the yarn defects. In the present example, the display of the set-point NSL2 representing the length 3.0 cm and the thickness 250% of the yarn defect and the display of the set-point

NSL3 representing the length 2.0 cm and the thickness 150% of the yarn defect (see FIG. 9) are changed to the display of the set-point NSL2 representing the length 2.0 cm and the thickness 150% of a yarn defect and the display of the set-point NSL3 representing the length 3.0 cm and the thickness 250% of a yarn defect (see FIG. 10).

[0054] As shown in FIG. 11, when a set-point NSL3 representing the length 2.0 cm and the thickness 150% of the yarn defect is changed to a set-point NSL3 representing the length 2.0 cm and the thickness 500% of the yarn defect, the processing section 42 generates the clearing limit 52 by connecting the set-points NSL1 to NSL5 in the order of the lengths of the yarn defects. As shown in FIG. 12, when a slub yarn K1 is set, the set-point NSL4 through which the clearing limit 52 passed before the setting of the slub yarn K1 is not removed from the two-dimensional field 51.

[0055] A concrete example of the selection of a set-point by touching is as follows. As shown in FIG. 13A, when multiple set-points A, B, and C are located on the clearing limit 52, and when the set-point B is touched, in addition to selecting the set-point B, a portion between the adjacent set points A and B, and a portion between the adjacent set-points B and C are automatically selected. As shown in FIG. 13B, when multiple set-points A, B, C, and D are located on the clearing limit 52, and when a portion between the adjacent set-points B and C is selected, in addition to selecting the set-points B and C, a portion between the adjacent set-points A and B, the portion between the adjacent set points B and C, and a portion between the adjacent set-points C and D are automatically selected.

[0056] As shown in FIG. 14A, in the clearing limit 52, when a slub yarn has been set by adjacent set-points B and C having the same thickness, when the set-point B is touched, in addition to selecting the set-point B, a portion between adjacent set points A and B, and a portion between the adjacent set-points B and C are automatically selected. In this example, only the length of the set-point B can be changed. As shown in FIG. 14B, in the clearing limit 52, when a slub yarn has been set by adjacent set-points B and C having the same thickness, when a portion between the adjacent set-points B and C is selected, in addition to selecting the set-points B and C, a portion between adjacent set-points A and B, a portion between the adjacent set points B and C, and a portion between adjacent set-points C and D are automatically selected. In this example, the distance between the adjacent set points B and C is fixed and the length and the thickness of the set-points B and C can be changed simultaneously.

[0057] In the main control device 4, when the operator touches in a certain manner (e.g., long press, button mashing, and the like) a portion where the clearing limit 52 is not displayed in the two-dimensional field 51, the point corresponding to the touched portion is added as a set-point. That is, the number of the set-points can be increased. For example, as shown in the upper part of

FIG. 15, by adding a set-point C near the clearing limit 52 that passes through set-points A and B, as shown in the lower part of FIG. 15, the clearing limit 52 can be changed so as to pass through the set-points A, B, and C. That is, when a desired position is touched in a certain manner in an area having a value of the length of the yarn defect that falls between the values of the adjacent set-points A and B, the new set-point C is added at the touched position. Then, the clearing limit 52 is changed by connecting the set-points A, B, and C in the order of the lengths of the yarn defects. In this manner, when the touch panel 41 displays the clearing limit 52 that is generated so as to pass through a plurality of first set-points (set-points A and B), the two-dimensional field 51 functions as a third input unit for accepting addition of at least one third set-point (set-point C). Thereafter, the processing section 42 generates the clearing limit 52 that passes through the first set-points and the at least one third set-point added by the operator by operating the third input unit and causes the touch panel 41 to display the newly generated clearing limit 52. With respect to the operation performed in the certain manner (touch operation) when adding the set-point, it is preferable that this operation is performed in a different manner from the operation performed in the certain manner (touch operation) when selecting the set-point on the clearing limit 52.

[0058] In the main control device 4, when a set-point on the clearing limit 52 is touched by the operator in a certain manner (e.g., long press, button mashing, and the like), that set-point is deleted. Moreover, when the operator touches in a certain manner the button 55 corresponding to a deletion target set-point (e.g., long press, button mashing, and the like), the set-point corresponding to the touched button is deleted. That is, the number of the set-points can be reduced. For example, as shown in the upper part of FIG. 16, by selecting in the certain manner a set-point B from the clearing limit 52 that passes through set-points A, B, and C, the set-point B can be deleted. When the set-point B is deleted, as shown in the lower part of FIG. 16, the clearing limit 52 is changed so as to pass through the set-points A and C other than the deleted set-point B. In this manner, when the touch panel 41 displays the clearing limit 52 that is generated so as to pass through a plurality of first set-points (set-points A, B, and B), the two-dimensional field 51 functions as a fourth input unit for accepting deletion of at least one first set-point (set-point B). In this case, the processing section 42 generates a new clearing limit 52 that passes through the first set-points (set-points A and C) other than the at least one first set-point (set-point B) deleted via any of the two-dimensional field 51 and the buttons 55 and causes the touch panel 41 to display the newly generated clearing limit 52. With respect to the operation performed in the certain manner (touch operation) when deleting the set-point, it is preferable that this operation is performed in a different manner from the operation performed in the certain manner (touch operation) when selecting the set-point on the clearing limit 52.

[0059] When the yarn defect data of a predetermined quantity is stored in the storage section 43 after the winding of the yarn is started in the main control device 4, the processing section 42 can automatically generate the clearing limit 52 based on a distribution state of the dots corresponding to the yarn defect data of the predetermined quantity in the two-dimensional field 51. This function is realized when the operator operates an automatic generation button 74 (see FIG. 4) displayed on the touch panel 41.

[0060] As explained above, in the main control device 4, the touch panel 41 displays the clearing limit 52 in the two-dimensional field 51, and when at least one first set-point is selected among a plurality of the first set-points (e.g., set-points NSL1 to NSL6 and T1 to T4) through which the clearing limit 52 passes and when at least one second set-point (e.g., set-points NSL2 to NSL4) is input as a movement destination of the selected at least one first set-point, the processing section 42 generates the clearing limit 52 that passes through the first set-points other than the selected at least one first set-point and the input at least one second set-point and causes the touch panel 41 to display the newly generated clearing limit 52 (see FIG. 6). In this manner, in the main control device 4, by selecting the at least one first set-point among the first set-points through which the clearing limit 52 passes and inputting the at least one second set-point as the movement destination of the selected at least one first set-point, the clearing limit 52 (in this example, the clearing limit 52 that passes through the first set-points other than the selected at least one first set-point and the input at least one second set-point) that passes through the input at least one second set-point can be generated. Thus, in the main control device 4, the clearing limit 52 can be set easily and suitably. Note that, in the main control device 4, the touch panel 41 displays the clearing limit 52 in the two-dimensional field 51, when one or more locations in the two-dimensional field 51 is touched, the processing section 42 assumes the touched location as the first set-point (e.g., set-points NSL1 to NSL6 and T1 to T4), generates the clearing limit 52 that passes through the first set-point and causes the touch panel 41 to display the newly generated clearing limit 52 (see FIG. 4). Therefore, the clearing limit 52 can be generated by an intuitive operation of simply touching the displayed two-dimensional field 51.

[0061] In the main control device 4, the processing section 42 causes the touch panel 41 to display a plurality of the first set-points (e.g., set-points NSL1 to NSL6 and T1 to T4) and the clearing limit 52 that passes through the first set-points, and at least one second set-point (e.g., set-points NSL2 to NSL4) and the clearing limit 52 that passes through the at least one second set-point (see FIG. 4). As a result, the operator can easily grasp the first set-points and the second set-points that form the basis of the generation of the clearing limit 52.

[0062] In the main control device 4, the first input unit (two-dimensional field 51 or the buttons 55) accepts se-

lection of at least one first set-point, and the second input unit (operation area 60) accepts input of at least one second set-point. Thus, the operator can easily and suitably set the clearing limit 52. If the first input unit is the two-dimensional field 51, the operator can easily select the first set-point that should be changed. If the first input unit is the buttons 55, the operator can easily select the first set-point that should be changed in a portion in which the clearing limit 52 is displayed in detail, for example. If the second input unit is the operation area 60, the operator can intuitively grasp the movement direction of the second set-point with respect to the first set-point that should be changed, and operate the operation area 60. It is allowable that the first input unit (two-dimensional field 51 or the buttons 55) accepts selection of all the first set-points, and the second input unit (operation area 60) accepts input of all the second set-points as the movement destinations of all the first set-points selected by using the first input unit. As a result, the operator can change the entire clearing limit 52. The selection of all the first set-points can be implemented by providing a button, for example, that accepts selection of all the first set-points.

[0063] In the main control device 4, when the touch panel 41 displays the clearing limit 52 that passes through a plurality of the first set-points (e.g., set-points A and B), the third input unit (two-dimensional field 51) accepts addition of at least one third set-point (e.g., set-point C) (see the upper part of FIG. 15). Then, the processing section 42 generates the clearing limit 52 that passes through the first set-points and the at least one third set-point added by the operator by operating the third input unit and causes the touch panel 41 to display the newly generated clearing limit 52 (see the lower part of FIG. 15). As a result, the operator can partially change the clearing limit 52. If the third input unit is the two-dimensional field 51, the operator can easily input the third set-point that should be added.

[0064] In the main control device 4, when the touch panel 41 displays the clearing limit 52 that passes through a plurality of the first set-points (e.g., set-points A, B, and C), the fourth input unit (two-dimensional field 51 or the buttons 55) accepts deletion of at least one first set-point (e.g., set-point B) (see the upper part of FIG. 16). Then, the processing section 42 generates the clearing limit 52 that passes through the first set-points other than the at least one first set-point deleted by the operator by operating the fourth input unit and causes the touch panel 41 to display the generated clearing limit 52 (see the lower part of FIG. 16). As a result, the operator can partially change the clearing limit 52. If the fourth input unit is the two-dimensional field 51, the operator can easily select the first set-point that should be deleted. If the fourth input unit is the buttons 55, the operator can easily select the first set-point that should be deleted in a portion in which the clearing limit 52 is displayed in detail, for example.

[0065] In this manner, in the main control device 4, when the processing section 42 generates the temporary

clearing limit 52 corresponding to the current clearing limit 52, the processing section 42 causes the touch panel 41 to display both the current clearing limit 52 and the temporary clearing limit 52. As a result, the operator can compare the current clearing limit 52 and the temporary clearing limit 52.

[0066] In the main control device 4, when the processing section 42 generates the temporary clearing limit 52 with respect to the current clearing limit 52, the processing section 42 calculates a first yarn processing result by using the current clearing limit 52 and the yarn defect data stored in the storage section 43 and calculates a second yarn processing result by using the temporary clearing limit 52 and the yarn defect data stored in the storage section 43. Then, the processing section 42 causes the touch panel 41 to display the calculated first yarn processing result and the calculated second yarn processing result. As a result, the operator can compare the first yarn processing result and the second yarn processing result, and can evaluate each of the current clearing limit 52 and the temporary clearing limit 52. It is preferable to simultaneously display both the first yarn processing result and the second yarn processing result on one screen of the touch panel 41.

[0067] In the main control device 4, the processing section 42 generates the guideline 75 by using the yarn defect data stored in the storage section 43 and causes the touch panel 41 to display the generated guideline 75 along with the dots representing the yarn defects. As a result, while looking at the guideline 75, the operator can touch somewhere in the two-dimensional field 51 to input the first set-point.

[0068] According to the present embodiment, by directly touching somewhere in the two-dimensional field 51, which has been displayed on the touch panel 41, in which the clearing limit 52 and the distribution of the yarn defects has been displayed, designation, change, addition, or deletion of the set-point (the first set-point, the second set-point, and the third set-point) through which the clearing limit 52 passes can be performed. Accordingly, the operator can set or change the clearing limit 52 intuitively.

[0069] The yarn winding machine 1 includes the yarn supplying section 21 that supplies the yarn, the winding section 24 that winds the yarn thereby forming the package, the yarn monitoring section 22 that monitors the yarn between the yarn supplying section 21 and the winding section 24 and detects a yarn defect, the yarn joining section 23 that performs the yarn joining operation to join the yarn from the yarn supplying section 21 and the yarn from the winding section 24 when the yarn is cut to remove the yarn defect detected by the yarn monitoring section 22, and the main control device 4. Because the yarn winding machine 1 includes the above-mentioned main control device 4, the yarn defect can be removed suitably.

[0070] The embodiments of the present invention are explained above. The present invention, however, is not

limited to the above embodiments. The clearing limit 52 is generated by connecting the adjacent set-points; however, the adjacent set-points need not be connected by a straight line. The adjacent set-points can be connected by a curved line, a stepped line, and the like. Moreover, the temporary clearing limit 52 can be generated by using the setting information (e.g., numerical values) input in the simulation setting values column 54.

[0071] Moreover, in the above embodiment, the main control device 4 of the yarn winding machine 1 functions as the clearing limit setting device; however, a management device and the like, for example, that is arranged at a distance from the yarn winding machine 1 can function as the clearing limit setting device. Moreover, the yarn winding machine 1 can include, separately from the main control device 4 that sets the winding condition (or spinning condition) of the yarn and monitors the operation state of the yarn winding machine 1, a clearing limit setting device dedicated to the yarn monitoring section 22. That is, for example, the clearing limit setting device dedicated to the yarn monitoring section 22 can be arranged parallel to the main control device 4 at the edge of the machine frame of the yarn winding machine 1. In these variations, the yarn defect data calculated by the yarn monitoring section 22 is either directly transmitted to the clearing limit setting device or indirectly (e.g., via the unit control device 3 or the main control device 4) transmitted to the clearing limit setting device.

[0072] Alternatively, in addition to acquiring the yarn defect data from the control device 22b of the yarn monitoring section 22, the processing section 42 can acquire waveform data that is output from the detecting device 22a of the yarn monitoring section 22. Alternatively, the processing section 42 can acquire only the waveform data output from the detecting device 22a of the yarn monitoring section 22 without acquiring the yarn defect data from the control device 22b of the yarn monitoring section 22. In such a configuration, the processing section 42 can calculate the yarn defect data based on the acquired waveform data.

[0073] In the above embodiment, the graph column 59 is displayed on the touch panel 41; however, it is allowable to have a configuration in which the graph column 59 is not displayed on a display section such as the touch panel 41. Moreover, it is allowable to have a configuration in which the current result column 56 and the simulation result column 57 are not displayed on the display section. Moreover, it is allowable to have a configuration in which the current setting values column 53 and the simulation setting values column 54 are not displayed on the display section.

[0074] In the above embodiment, each of the clearing limits 52a and 52b is constituted by less than 10 set-points (first set-points). However, each of the clearing limits can be constituted by 10 or more set-points. The number of set-points that constitute the clearing limit 52a for removing the thick yarn defects and the number of set-points that constitute the clearing limit 52b for remov-

ing the thin yarn defects can be the same or different. Because the types of the yarn defects of the thick yarn defects that need to be distinguished are more than the types of the thin yarn defects, it is desirable that the number of the set-points that constitute the clearing limit 52a for removing the thick yarn defects is more than the number of the set-points that constitute the clearing limit 52b for removing the thin yarn defects.

[0075] In the present embodiment, the display section is constituted by the touch panel 41. However, the display section can be constituted by a display device that is not a touch panel. In this case, an operating section (e.g., mouse, key button, and the like) can be arranged separately, and the designation, change, addition, deletion, and movement of the set-point (the first set-point, the second set-point, the third set-point) through which the clearing limit 52 passes can be performed by using this operating section. For example, if the operating section is a mouse, a desired one among the first set-points through which the clearing limit 52 passes can be selected by clicking (first operation), and, a desired position in the two-dimensional field 51 can be input by clicking as the second set-point that is the movement destination of the selected first set-point. Moreover, for example, a desired position in the two-dimensional field 51 can be double-clicked (second operation) to add the third set-point. Moreover, for example, a desired one among the first set-points through which the clearing limit 52 passes can be double-clicked to delete that first set-point.

[0076] In the above explanation, the meaning of "a plurality of" also includes "a predetermined number of".

Claims

1. A clearing limit setting device (4) comprising:

a display section (41) configured to display, in a two-dimensional field (51) constituted by a length and a thickness of a yarn defect as coordinate axes, a clearing limit (52) that is a boundary line that defines whether to remove a yarn defect from a yarn; and
a processing section (42) configured to, when at least one first set-point is selected among a plurality of the first set-points (NSL1 to NSL6 and T1 to T4) through which the clearing limit (52) passes and at least one second set-point is input as a movement destination of the selected at least one first set-point, generate a clearing limit (52) that passes through the at least one second set-point instead of the selected at least one first set-point, and cause the display section (41) to display the newly generated clearing limit (52).

2. The clearing limit setting device (4) as claimed in Claim 1, wherein the processing section (42) is con-

- figured to cause the display section (41) to simultaneously display the first set-points (NSL1 to NSL6 and T1 to T4) and the clearing limit (52) that passes through the first set-points (NSL1 to NSL6 and T1 to T4), and the at least one second set-point and the clearing limit (52) that passes through the at least one second set-point.
3. The clearing limit setting device (4) as claimed in Claim 1 or 2, comprising a first input unit (51, 55) configured to accept selection of the at least one first set-point, and a second input unit (60) configured to accept input of the at least one second set-point.
 4. The clearing limit setting device (4) as claimed in Claim 3, wherein the first input unit (51) is the two-dimensional field (51) displayed on the display section (41).
 5. The clearing limit setting device (4) as claimed in Claim 3 or 4, wherein the display section (41) is configured to display a plurality of buttons (55) that respectively correspond to the first set-points (NSL1 to NSL6 and T1 to T4), and the first input unit (55) is the buttons (55) displayed on the display section (41).
 6. The clearing limit setting device (4) as claimed in any one of Claims 3 to 5, wherein the display section (41) is configured to display an operation area (60) that includes a plurality of movement direction setting buttons (61) that shows movement directions and accepts selection of the movement directions, and the second input unit (60) is the operation area (60) displayed on the display section (41).
 7. The clearing limit setting device (4) as claimed in any one of Claims 1 to 6, comprising a third input unit (51) configured to accept addition of at least one third set-point when the display section (41) displays the clearing limit (52) that passes through the first set-points (NSL1 to NSL6 and T1 to T4), wherein the processing section (42) is configured to generate the clearing limit (52) that passes through the first set-points and the at least one third set-point added by the third input unit (51) and causes the display section (41) to display the newly generated clearing limit (52).
 8. The clearing limit setting device (4) as claimed in Claim 7, wherein the third input unit (51) is the two-dimensional field (51) displayed on the display section (41).
 9. The clearing limit setting device (4) as claimed in any one of Claims 1 to 8, comprising a fourth input unit (51, 55) configured to accept deletion of at least one first set-point when the display section (41) displays the clearing limit (52) that passes through the first set-points (NSL1 to NSL6 and T1 to T4), wherein the processing section (42) is configured to generate the clearing limit (52) that passes through the first set-points other than the at least one first set-point deleted by the fourth input unit (51, 55) and causes the display section (41) to display the newly generated clearing limit (52).
 10. The clearing limit setting device (4) as claimed in Claim 9, wherein the fourth input unit (51) is the two-dimensional field (51) displayed on the display section (41).
 11. The clearing limit setting device (4) as claimed in Claim 9 or 10, wherein the display section (41) is configured to display a plurality of buttons (55) that respectively correspond to the first set-points (NSL1 to NSL6 and T1 to T4), and the fourth input unit (55) is the buttons (55) displayed on the display section (41).
 12. The clearing limit setting device (4) as claimed in any one of Claims 1 to 11, comprising a storage section (43) configured to store therein yarn defect data containing the length and the thickness of each of a plurality of yarn defects, wherein the processing section (42), when newly generating the clearing limit (52) with respect to the currently set clearing limit (52), is configured to calculate a first yarn processing result by using the yarn defect data and the currently set clearing limit (52) and calculates a second yarn processing result by using the yarn defect data and the newly generated clearing limit (52), and to cause the display section (41) to display the calculated first yarn processing result and the second yarn processing result.
 13. The clearing limit setting device (4) as claimed Claim 12, wherein the processing section (42) is configured to generate a guideline (75) by using the yarn defect data, and to cause the display section (41) to display the generated guideline (75) along with dots that represent the yarn defects.
 14. The clearing limit setting device (4) as claimed in any one of Claims 1 to 11, comprising a storage section (43) configured to store therein yarn defect data containing the length and the thickness of each of a plurality of yarn defects, wherein

the processing section (42) is configured to generate a guideline (75) by using the yarn defect data, and to cause the display section (41) to display the generated guideline (75) along with dots that represent the yarn defects.

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15. A yarn winding machine (1) comprising:

a plurality of yarn winding units (2) each including

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a yarn supplying section (21) configured to supply a yarn;

a winding section (24) configured to wind the yarn to form a package; and

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a yarn monitoring section (22) configured to monitor the yarn between the yarn supplying section (21) and the winding section (24) to detect a yarn defect; and

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a clearing limit setting device (4) as claimed in any one of Claims 1 to 14.

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FIG.1

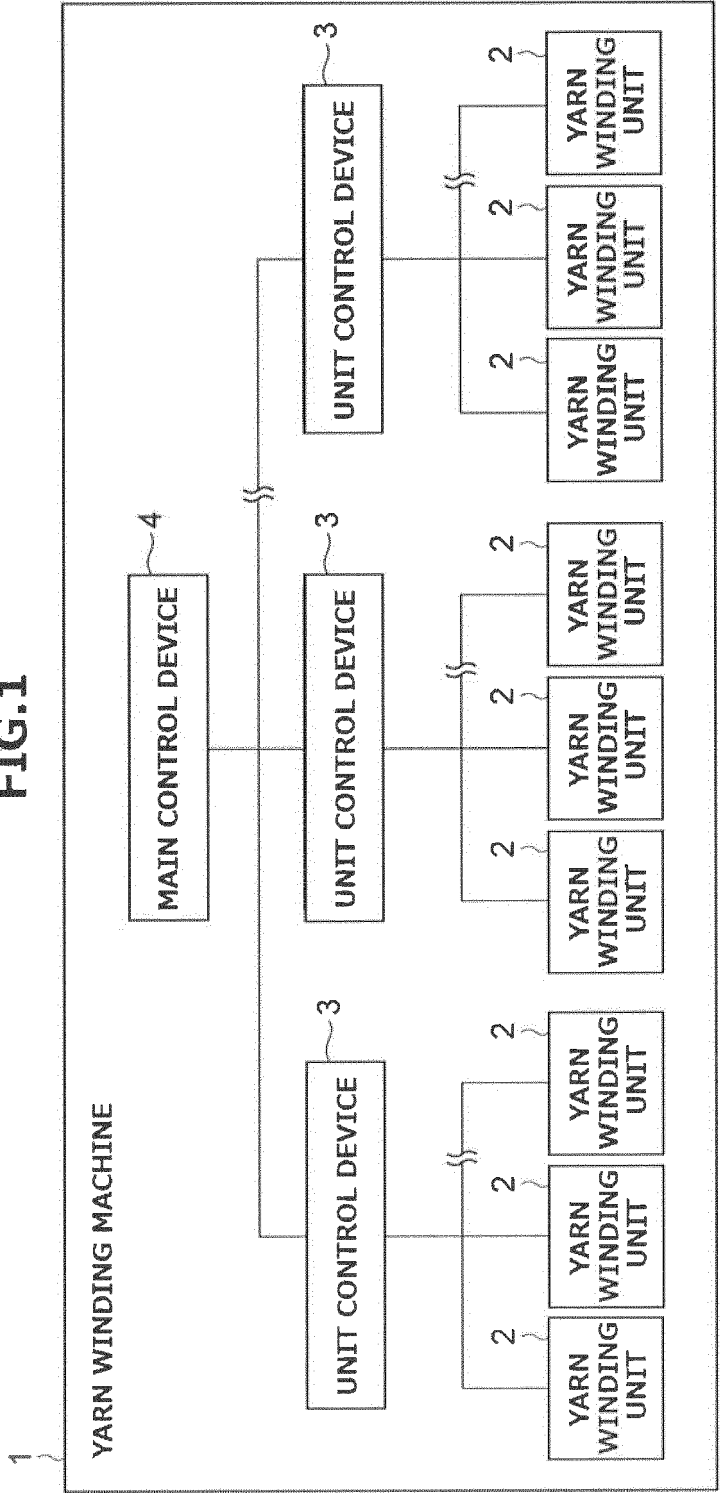


FIG.2

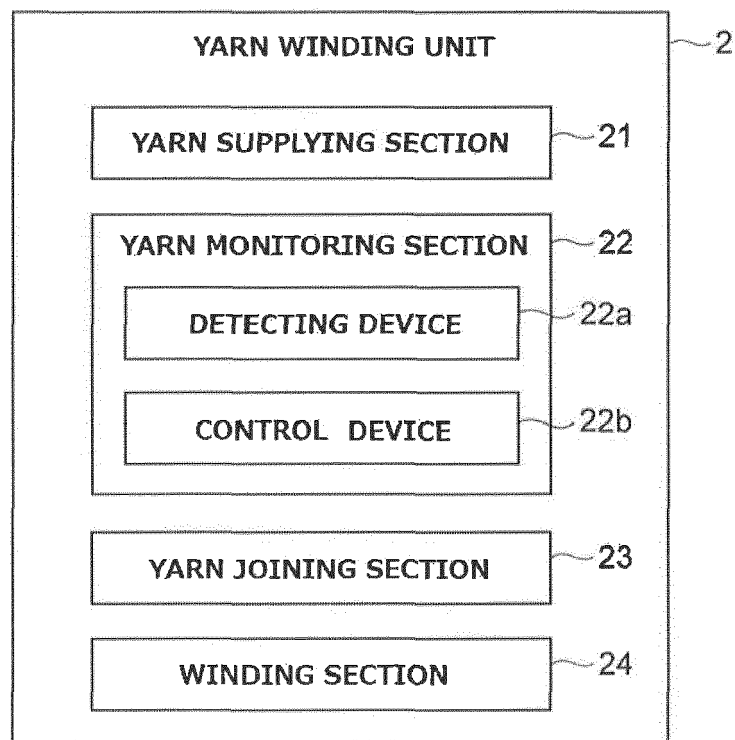


FIG. 3

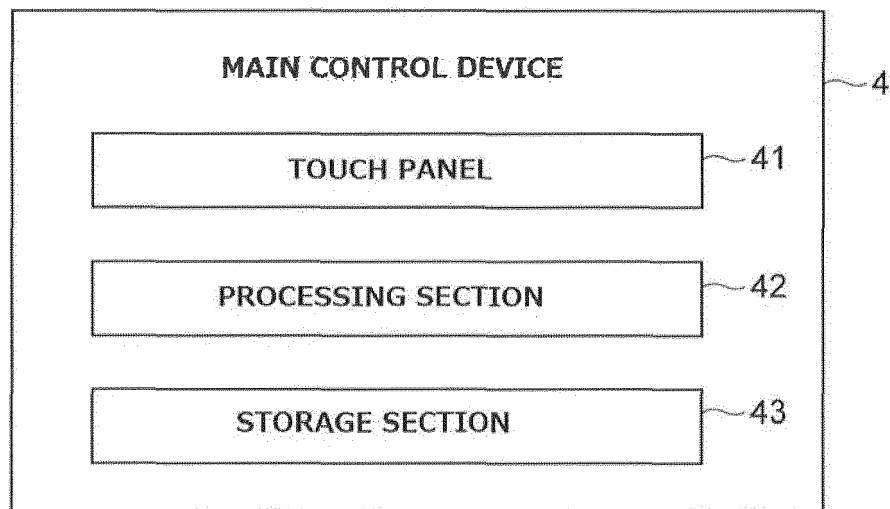


FIG.4

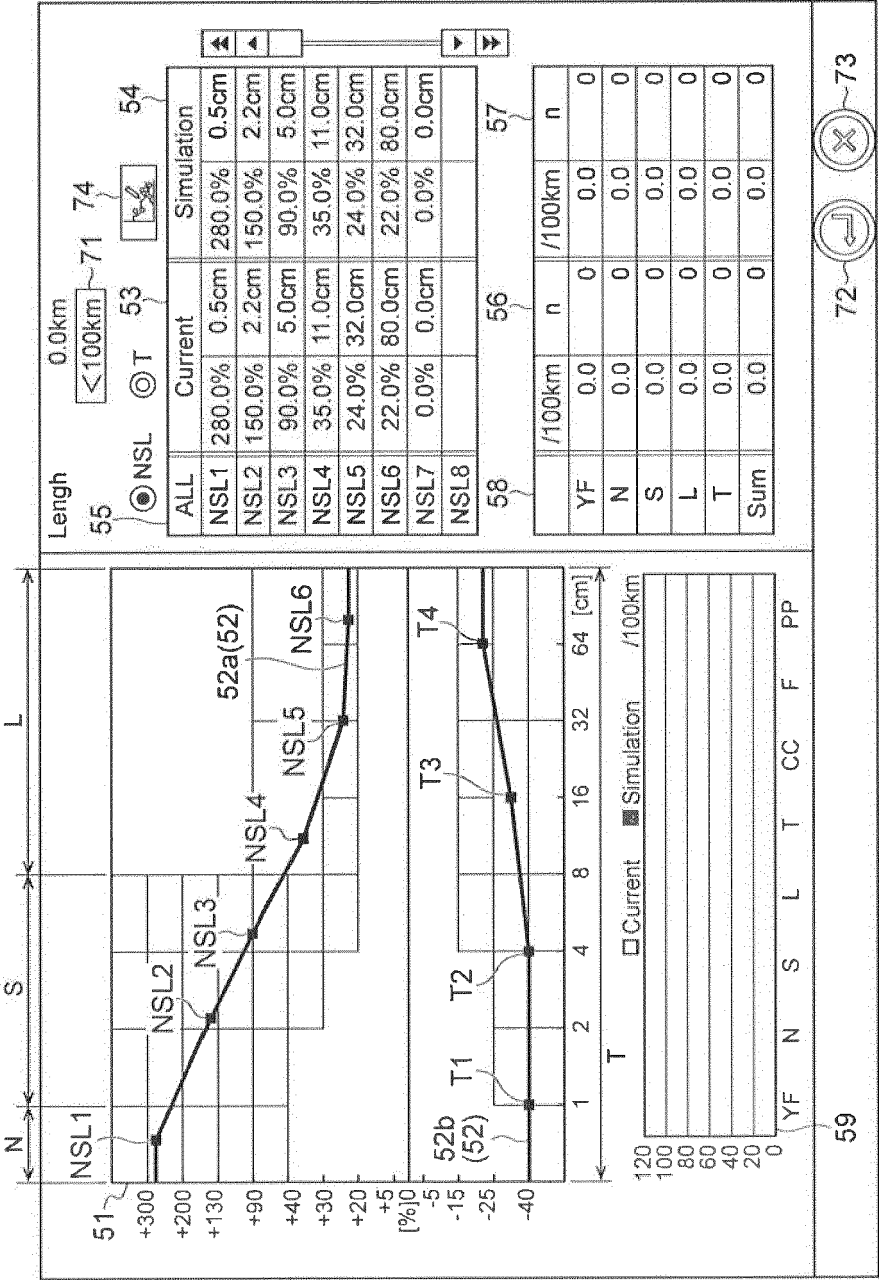


FIG.5

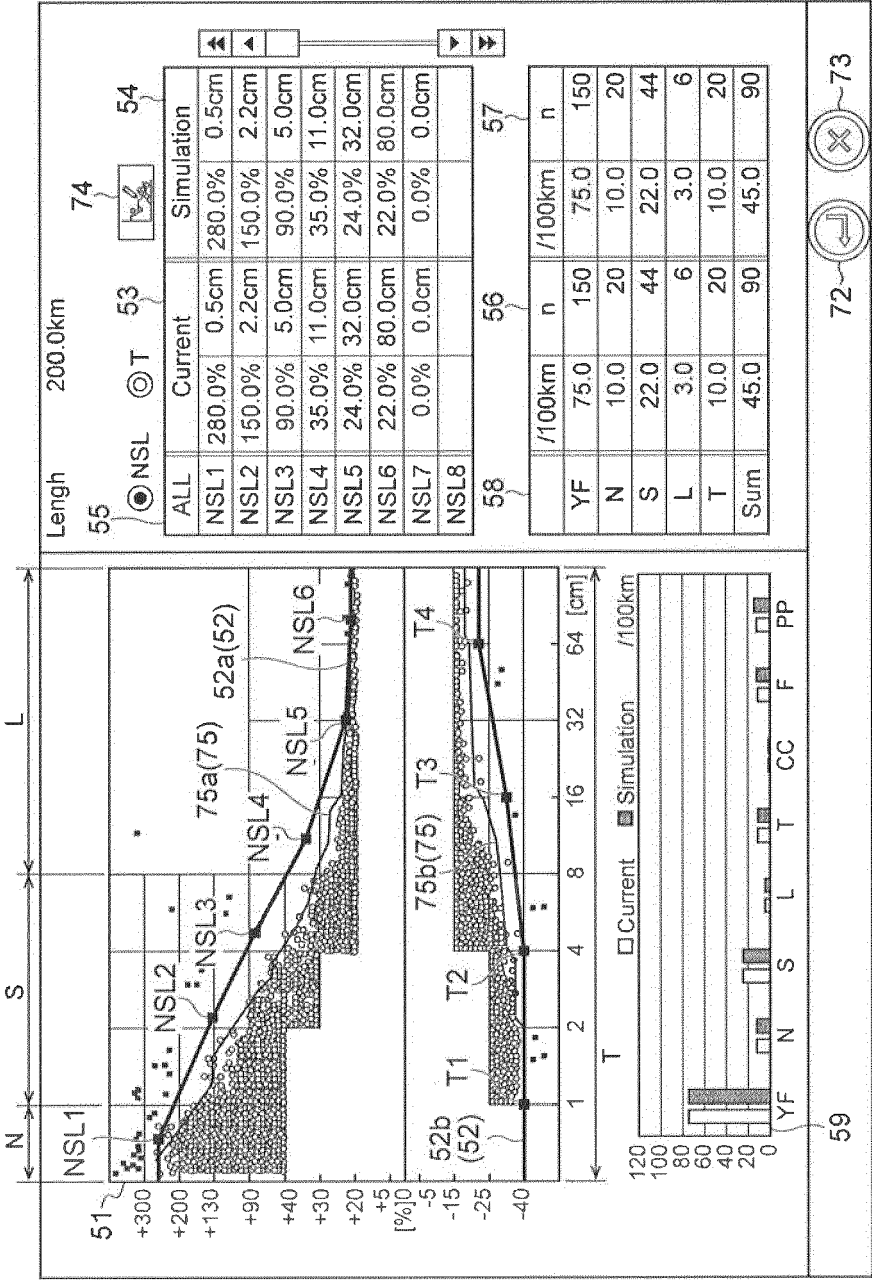


FIG.6

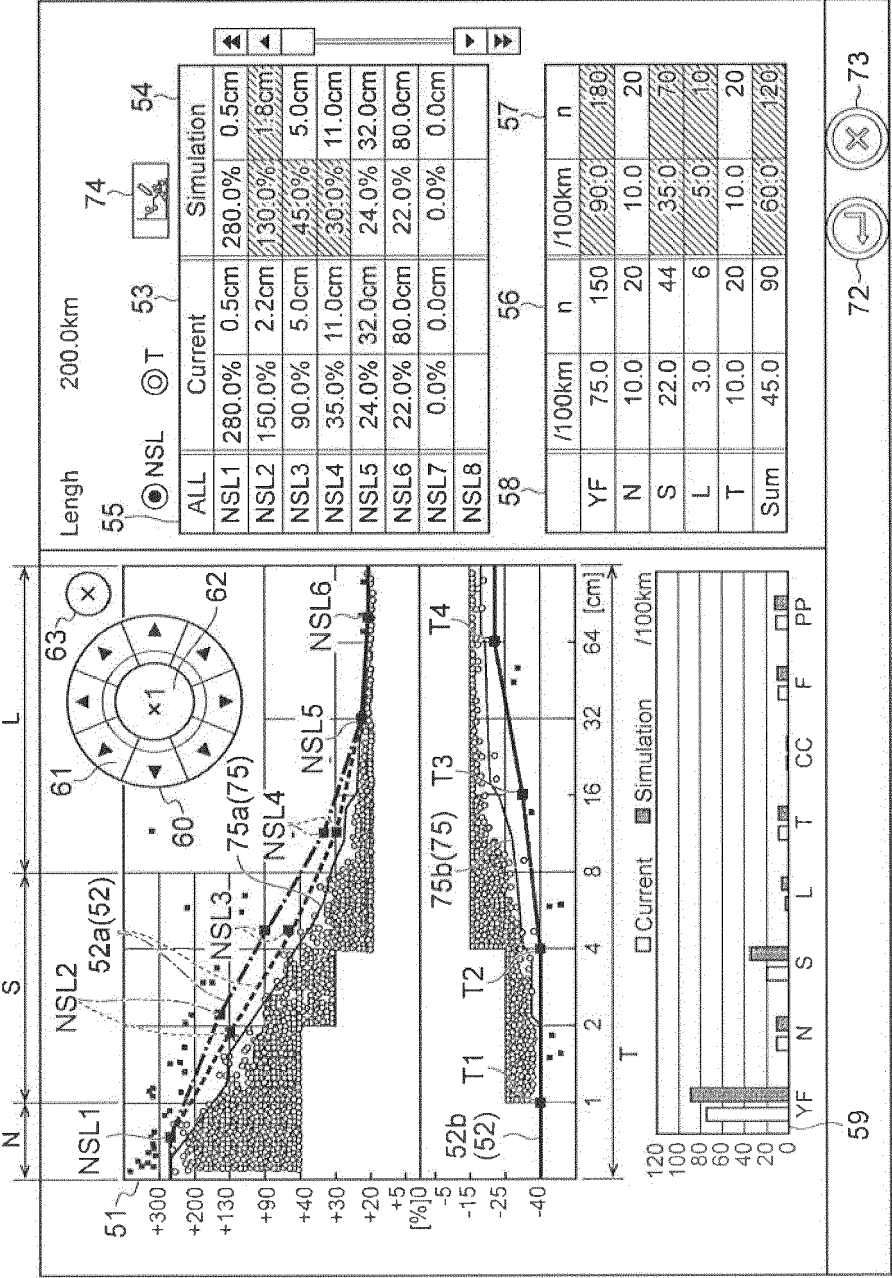


FIG.7

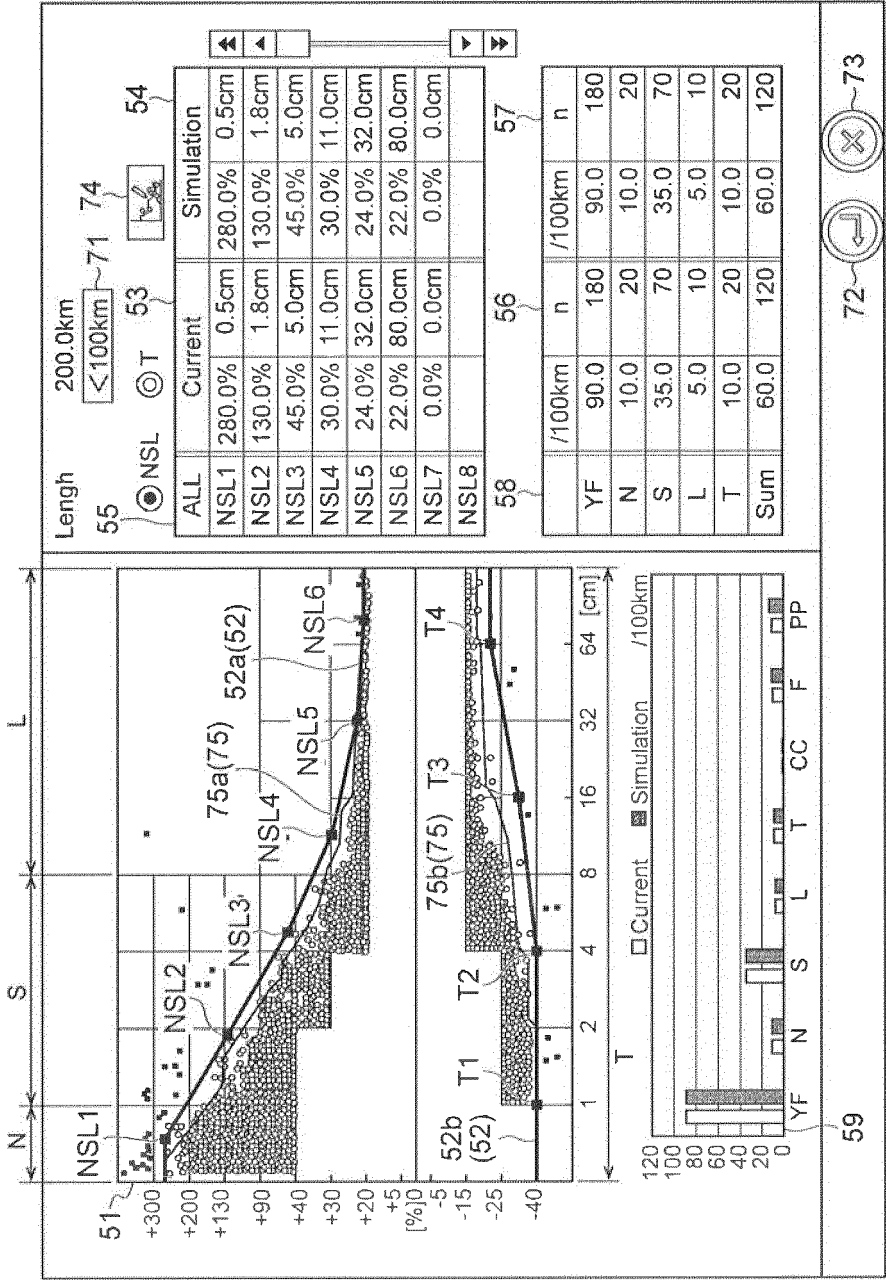


FIG.8

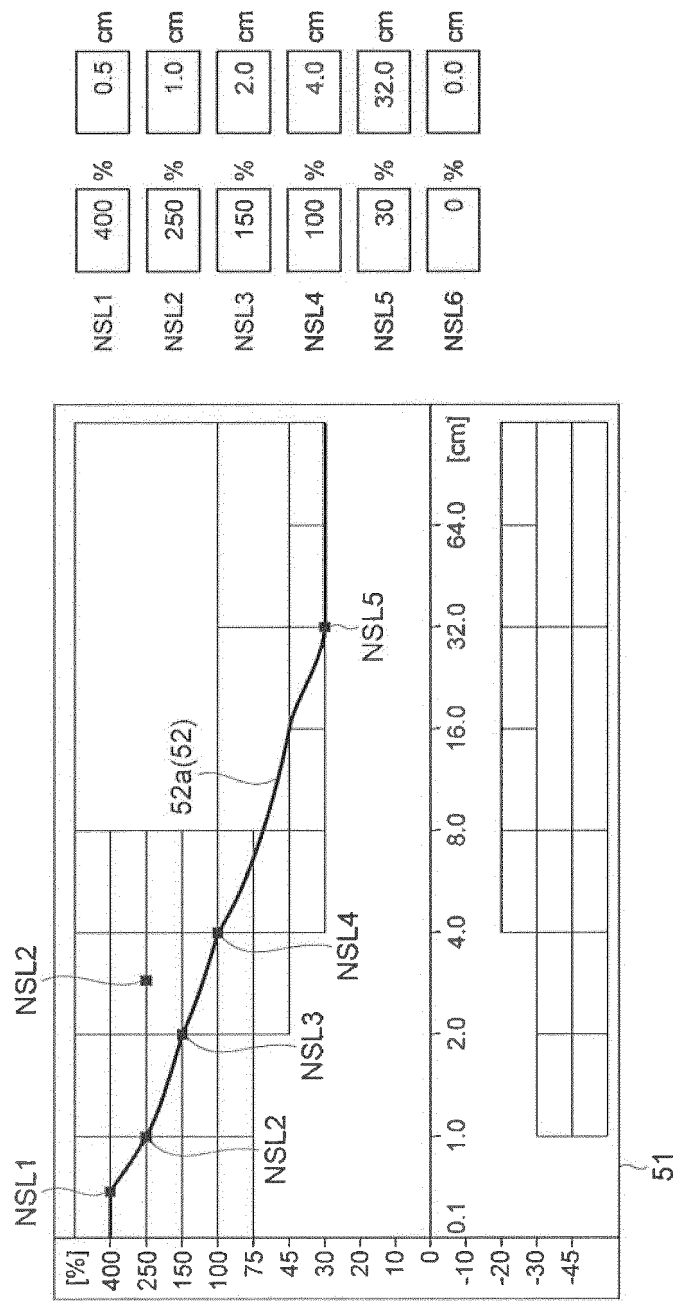


FIG.9

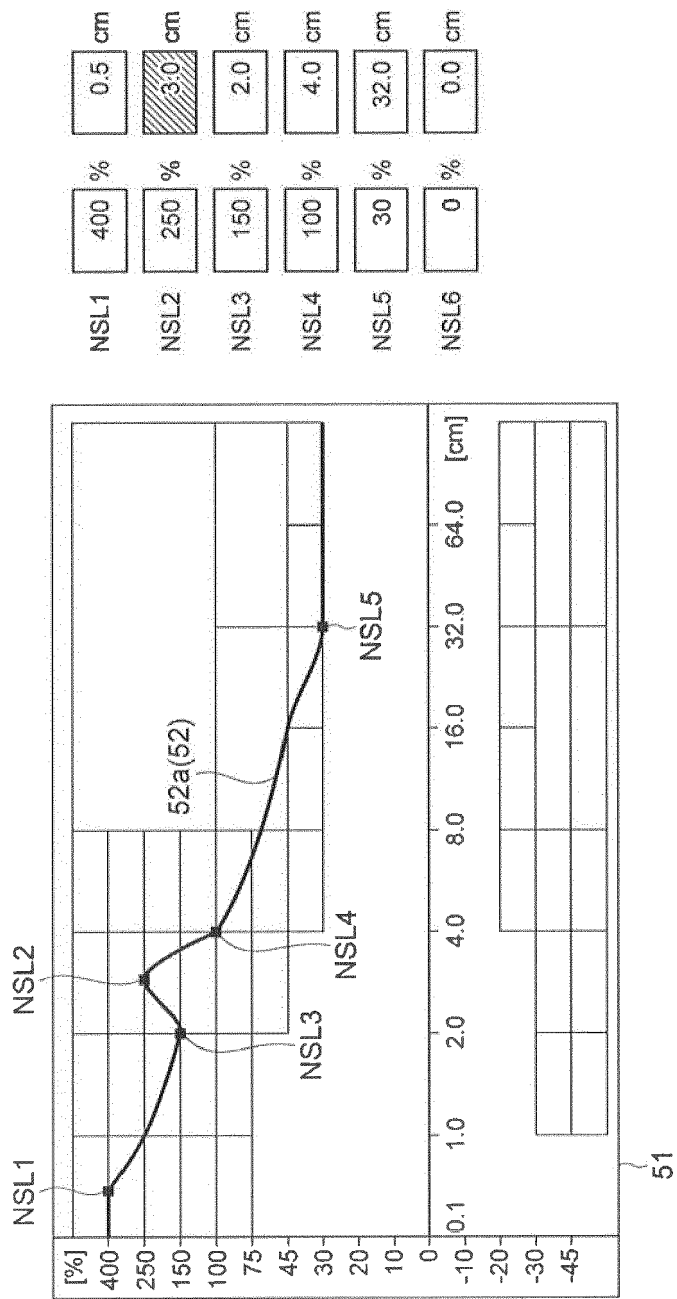


FIG.10

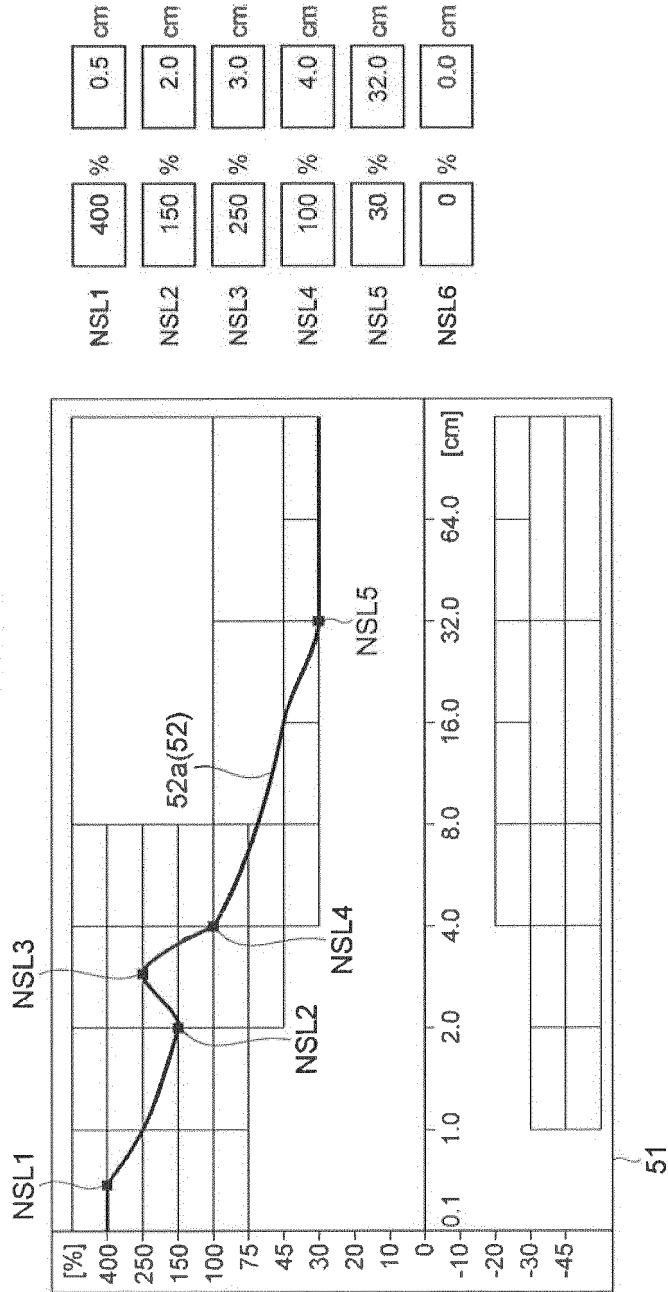


FIG.11

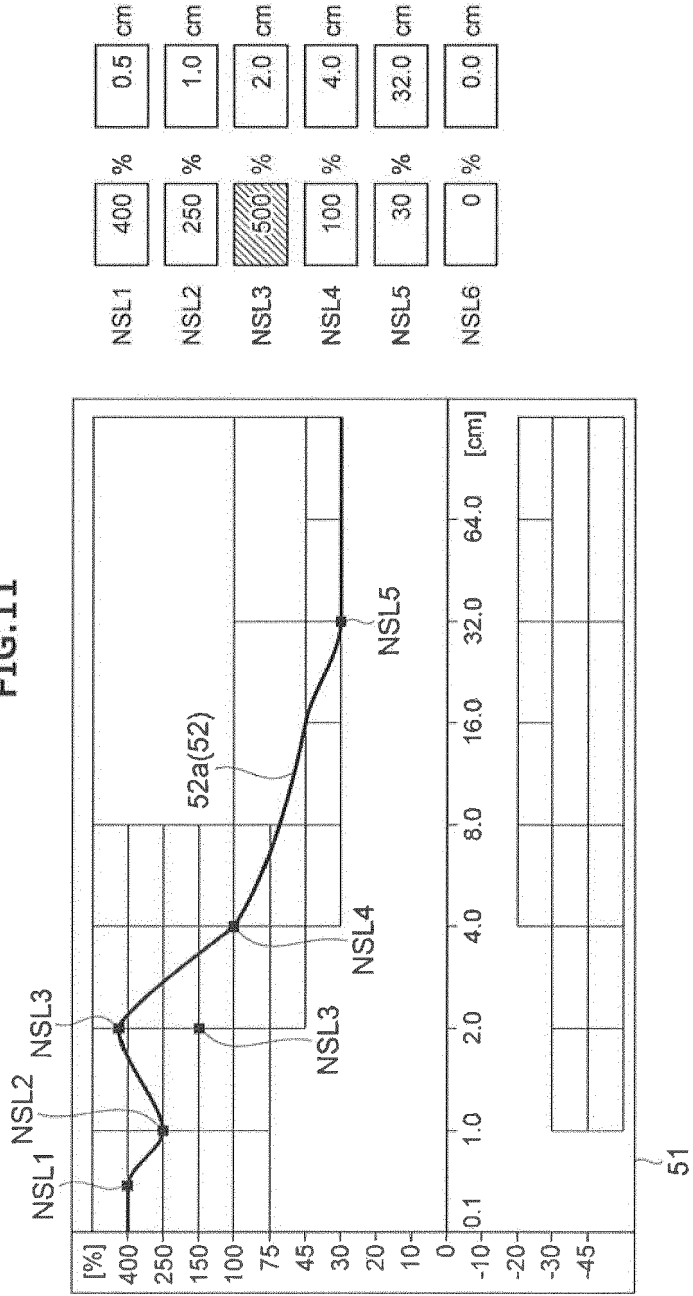


FIG.12

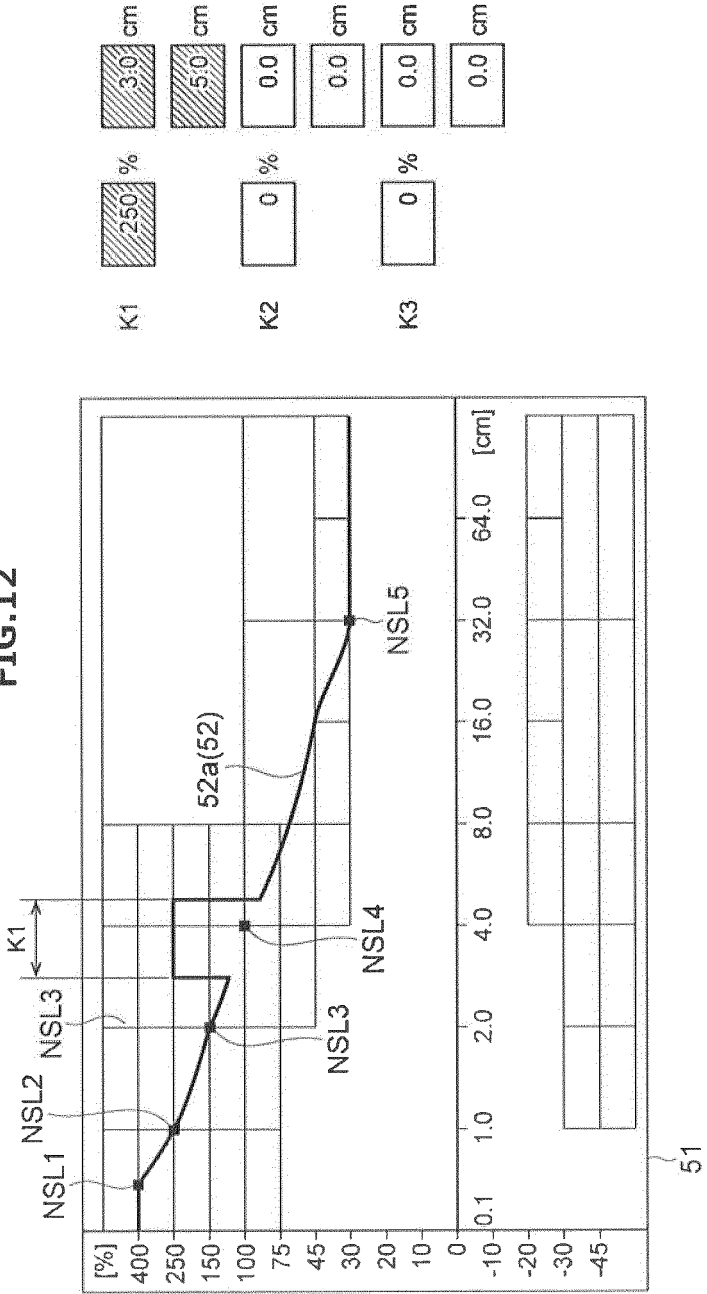


FIG.13A

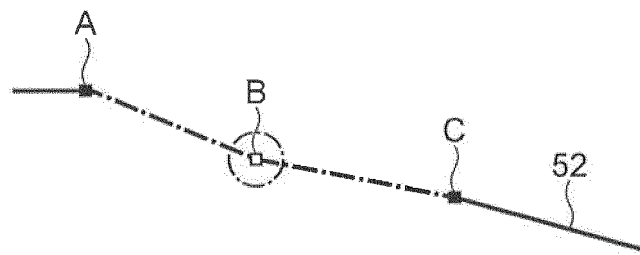


FIG.13B

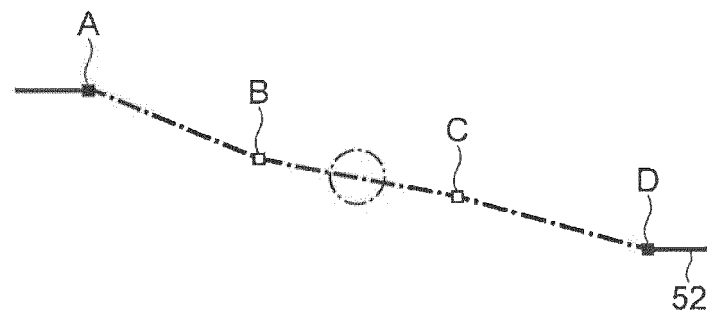


FIG.14A

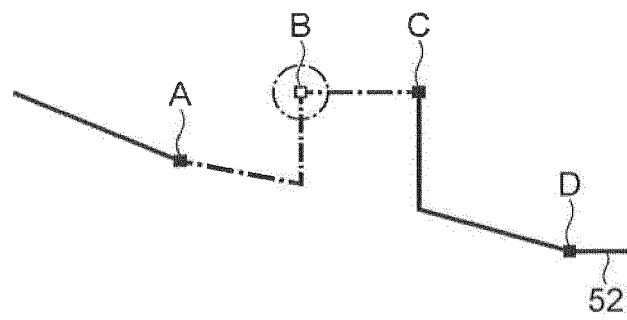


FIG.14B

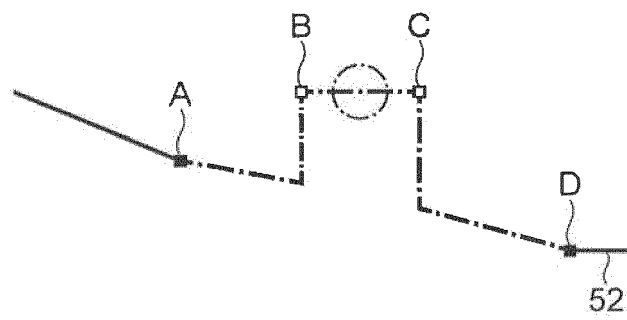


FIG.15

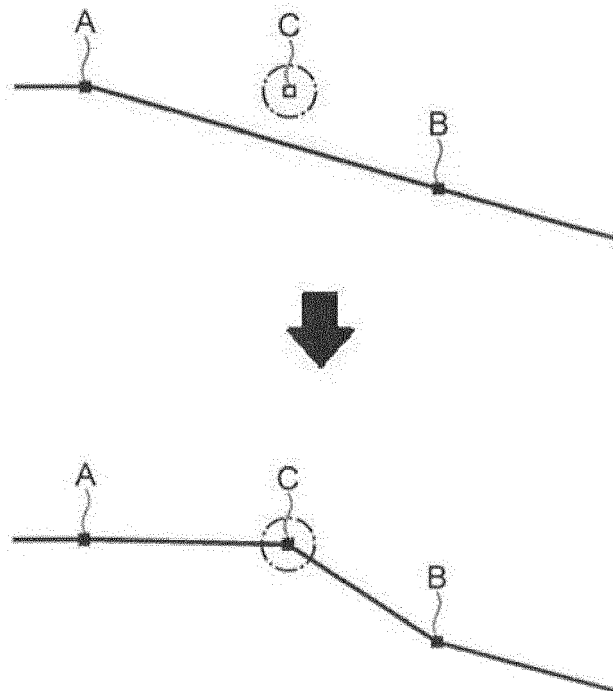
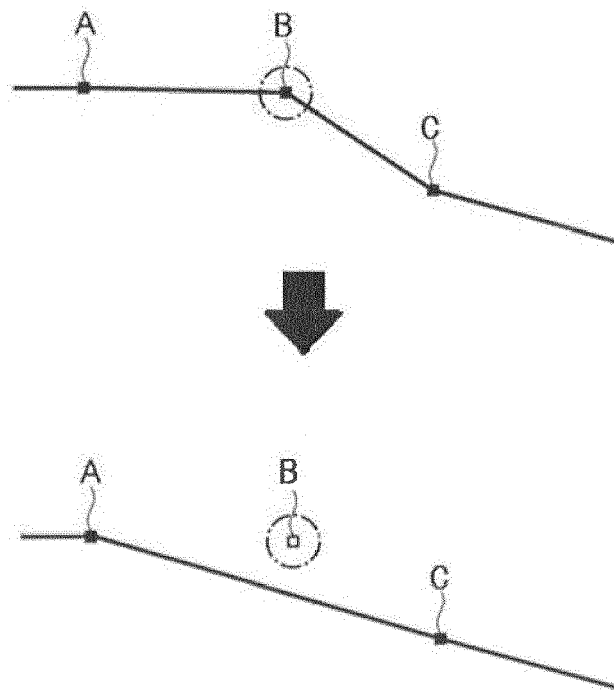


FIG.16





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