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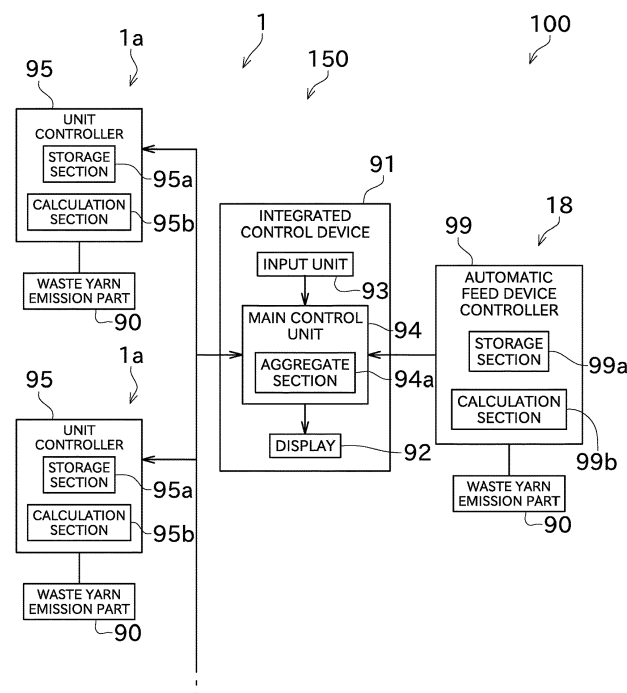
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(54) **WASTE YARN EMISSION AMOUNT OUTPUT DEVICE AND TEXTILE MACHINE**

(57) A waste yarn emission amount output device 150 includes a calculation section 95b and a display 92. The calculation section 95b calculates and outputs a waste yarn emission amount from each of devices in an

automatic winder 1, these devices emitting waste yarns. The display 92 displays a waste yarn emission amount outputted by the calculation section 95b.

Fig.4



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates mainly to an output device that outputs the amount of waste yarn emitted from a textile machine.

2. Description of the Related Art

[0002] A textile machine such as an automatic winder, which processes fiber bundles and/or yarns for example, emits unwanted cotton fly and the like (to-be-removed materials) while the machine is operating.

[0003] Leaving the to-be-removed materials as they are may lead to a degraded package quality due to adherence of the to-be-removed materials to the package or the like, or may cause a fault in the textile machine itself. This is why a configuration has been conventionally known that is capable of sucking and removing to-be-removed materials by applying a suction flow to an appropriate region.

[0004] Devices capable of integrated control on such a textile machine are disclosed in, for example, following patent JP2007-211363A, WO2016/074767, and WO2015/029275.

[0005] JP2007-211363A discloses a display device that simulates and displays a yarn defect subjected to cut and removal in a clearing process as well as a status of remaining yarn defects.

[0006] WO2016/074767 discloses a display device that displays power consumption of a textile machine.

[0007] WO2015/029275 discloses an integrated control device for a yarn drawing device that sucks a upper yarn with a suction mouth.

SUMMARY OF THE INVENTION

[0008] In a factory where a textile machine is operating, information on the amount of waste yarn emission is important from the viewpoint of, for example, preventing waste of resources. In this respect, however, the references listed above do not provide a configuration that enables the amount of waste yarn emission to be grasped quantitatively.

[0009] In a conventional textile machine, the amount of waste yarn cannot be grasped unless a weight scale is used to measure waste yarns collected from respective devices. The conventional configuration, therefore, leaves room for improvement, because it takes time and labor to acquire information on the amount of waste yarn.

[0010] The present invention has been accomplished in view of such circumstances, and aims to grasp the amount of waste yarn emitted from a textile machine with a simple configuration.

[0011] The foregoing has described problems to be

solved by the present invention. The following will describe solutions to the problems and advantageous effects thereof.

[0012] A first aspect of the present invention provides a waste yarn emission amount output device configured as follows. The waste yarn emission amount output device includes an output section and a display unit. The output section calculates and outputs a waste yarn emission amount from each of devices in a textile machine, the devices emitting waste yarns. The display unit displays a waste yarn emission amount outputted by the output section.

[0013] Based on what is displayed on the display unit, an operator can easily obtain information that is useful in terms of an environmental load, an effective use of resources, and the like. Moreover, the operator can obtain information on a waste yarn emission amount without the need to actually measure a waste yarn weight and the like. Accordingly, a simple configuration can be achieved.

[0014] The waste yarn emission amount output device is preferably configured as follows. The textile machine includes a yarn feed part, a winding part, and a yarn joining device. A yarn is drawn out from the yarn feed part. The winding part winds a yarn fed from the yarn feed part, to form a package. The yarn joining device performs yarn joining when a yarn is broken at a location between the yarn feed part and the winding part. The winding part includes a winding drum that comes into contact with the package to cause slave rotation of the package. When the yarn joining device performs yarn joining, the output section calculates a waste yarn emission amount based on a rotation angle through which the winding drum is rotated in a direction reverse to a direction in which the winding drum is rotated in order to draw out a yarn from the winding part at a time of winding. Here, in a case where the winding drum makes one or more rotations in the reverse direction, an accumulated angle serves as the rotation angle.

[0015] With this configuration, the waste yarn emission amount is calculated in accordance with how much the yarn is unwound from the package at a time of yarn joining, and therefore the waste yarn emission amount can be obtained accurately.

[0016] The waste yarn emission amount output device is preferably configured as follows. The textile machine includes a yarn feed part, a winding part, and a yarn joining device. A yarn is drawn out from the yarn feed part. The winding part winds a yarn fed from the yarn feed part, to form a package. The yarn joining device performs yarn joining when a yarn is broken at a location between the yarn feed part and the winding part. When the yarn joining device performs yarn joining, the output section calculates a waste yarn emission amount based on a rotation angle through which the package is rotated in a direction reverse to a direction in which the package is rotated in order to draw out a yarn from the winding part at a time of winding. Here, in a case where the package

makes one or more rotations in the reverse direction, an accumulated angle serves as the rotation angle.

[0017] With this configuration, the waste yarn emission amount is calculated in accordance with how much the yarn is unwound from the package at a time of yarn joining, and therefore the waste yarn emission amount can be obtained accurately.

[0018] The waste yarn emission amount output device is preferably configured as follows. The textile machine includes a yarn feed part, a winding part, a yarn joining device, and a yarn guide device. A yarn is drawn out from the yarn feed part. The winding part winds a yarn fed from the yarn feed part, to form a package. The yarn joining device performs yarn joining when a yarn is broken at a location between the yarn feed part and the winding part. The yarn guide device sucks and catches a yarn unwound from the yarn feed part, and guides the yarn to the yarn joining device. When the yarn joining device performs yarn joining, the output section calculates a waste yarn emission amount based on a time length for which the yarn guide device keeps sucking the yarn.

[0019] Since the waste yarn emission amount is calculated in accordance with how much the yarn is unwound from the yarn feed part at a time of yarn joining, the waste yarn emission amount can be obtained accurately.

[0020] The waste yarn emission amount output device is preferably configured as follows. The textile machine includes a yarn feed part, a winding part, a yarn joining device, and a yarn guide device. A yarn is drawn out from the yarn feed part. The winding part winds a yarn fed from the yarn feed part, to form a package. The yarn joining device performs yarn joining when a yarn is broken at a location between the yarn feed part and the winding part. The yarn guide device sucks and catches a yarn unwound from the yarn feed part, and guides the yarn to the yarn joining device. When the yarn joining device performs yarn joining, the output section calculates a waste yarn emission amount based on the number of times the yarn guide device is operated.

[0021] Since the waste yarn emission amount is calculated in accordance with how much the yarn guide device is operated, the waste yarn emission amount can be obtained accurately.

[0022] In the waste yarn emission amount output device, it is preferable that displaying of a waste yarn emission amount on the display unit is updated while the textile machine is operating.

[0023] Accordingly, promptness of the displaying can be obtained easily. Thus, even when a waste yarn emission amount has an unusual status during an operation of the textile machine, it is easy to deal with the status at an early stage.

[0024] The waste yarn emission amount output device is preferably configured as follows. The waste yarn emission amount output device is configured such that setting on an operation of the devices that emit waste yarns is

changeable. In changing the setting, a simulation calculation result indicating a waste yarn emission amount that would be caused by the change is displayed on the display unit.

[0025] Accordingly, when the operator makes setting, the operator can refer to how the waste yarn emission amount will be influenced in advance.

[0026] In the waste yarn emission amount output device, it is preferable that the display unit simultaneously displays not only the waste yarn emission amount but also at least either of power consumption in the textile machine or compressed air consumption in the textile machine.

[0027] This can enhance completeness of information, allowing an overall status of the textile machine to be grasped easily.

[0028] The waste yarn emission amount output device is preferably configured as follows. The textile machine includes a plurality of winding units that wind yarns. Each of the winding units is provided with at least one device that emits a waste yarn.

[0029] This configuration enables a waste yarn emission amount from the textile machine to be grasped easily, even if there are many devices that emit waste yarns.

[0030] In the waste yarn emission amount output device, it is preferable that the display unit is capable of displaying a total waste yarn emission amount from the plurality of winding units.

[0031] This makes it possible for the operator to compare the total waste yarn emission amount from the plurality of winding units with a waste yarn emission amount from another part, for examination.

[0032] The waste yarn emission amount output device is preferably configured as follows. The display unit is capable of displaying the emission amount of a first waste yarn and the emission amount of a second waste yarn from the plurality of winding units as a whole, where the first and second waste yarns represent waste yarns emitted at locations respectively downstream and upstream of a yarn broken portion in each winding unit with respect to a yarn travel direction.

[0033] This enables a tendency of emission of waste yarns to be grasped in detail.

[0034] A second aspect of the present invention provides a textile machine including the waste yarn emission amount output device.

[0035] Accordingly, a reduction of a waste yarn emission amount can be achieved easily.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036]

FIG. 1 is a schematic plan view of an automatic winder system including an automatic winder according to an embodiment of the present invention.

FIG. 2 is a front view showing an overall configuration of the automatic winder.

FIG. 3 is a side view of a winder unit.

FIG. 4 is a block diagram of the automatic winder system.

FIG. 5 shows what is displayed on a display.

FIG. 6 shows a situation where a simulation result on the amount of waste yarn emission is displayed in accordance with a change of setting.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0037] An embodiment of the present invention will be described with reference to the drawings. FIG. 1 is a schematic plan view of an automatic winder system 100 including an automatic winder 1 according to an embodiment of the present invention. FIG. 2 is a front view showing an overall configuration of the automatic winder 1. FIG. 3 is a side view of a winder unit 1a. FIG. 4 is a block diagram of the automatic winder system 100. FIG. 5 shows what is displayed on a display 92.

[0038] The automatic winder system (textile machine system) 100 shown in FIG. 1 includes the automatic winder (textile machine) 1, a bobbin preparation system 2, and a bobbin feed device 3. The bobbin preparation system 2 and the bobbin feed device 3 constitute a automatic bobbin feed device 18.

[0039] In a factory where the automatic winder system 100 is operating, a compressed air supply source 50 is installed. The compressed air supply source 50 is constituted by, for example, a compressor or the like. While compressed air supplied from the compressed air supply source 50 is sent, the compressed air diverges into common air pipes each corresponding to each of systems. An air supply path is connected to each of the common air pipes. Through the air supply path, each device of the automatic winder system 100 is supplied with necessary air.

[0040] The automatic winder system 100 implements removal of fiber debris and waste yarns (cleaning mechanism) with air blast which means blowing of compressed air. The automatic winder system 100 also drives a cutter, and drives an air cylinder to drive a brake. The automatic winder 1 includes yarn joining devices 26, which will be detailed later. The yarn joining device 26 uses supplied air to perform yarn joining by, for example, untwisting and twisting a yarn. The automatic winder 1 also uses compressed air to make an airflow for conveying a spun yarn 10. Here, the waste yarn means a part of a yarn (spun yarn 10) that is to be wound by the textile machine (automatic winder 1) but is not wound as a result of breakage of the yarn (spun yarn 10) with some cause. Examples of the some cause include voluntary cutting of the yarn implemented by an operation of the textile machine, occurrence of yarn cutting due to an excessive force applied to a yarn defect, and the like.

[0041] A yarn feed bobbin 12 includes a bobbin tube 120 around which a spun yarn (yarn) 10 is wound. The spun yarn (yarn) 10 has been produced in an upstream

process by a fine spinning machine 40.

[0042] Referring to FIG. 2, the automatic winder 1 includes, as main components, a plurality of winder units (winding unit) 1a arranged side by side, a cotton collection box 19, a blower box 80, a motor box 85, and a doffing cart 17. As shown in FIG. 1, the automatic winder 1 has a feed passage 4 through which a yarn feed bobbin 12 is automatically conveyed to each winder unit 1a. The automatic winder 1 also has a collection passage 5 through which a bobbin 13 discharged from each winder unit 1a is conveyed.

[0043] The feed passage 4 and the collection passage 5, which are constituted by a belt conveyor or the like, is able to convey a conveyance tray 16. FIG. 1 illustrates only a few yarn feed bobbins 12 and a few bobbins 13, but actually, many yarn feed bobbins 12 are conveyed through the feed passage 4 and many bobbins 13 are conveyed through the collection passage 5.

[0044] Each winder unit 1a unwinds a spun yarn 10 from a yarn feed bobbin 12, and winds the unwound spun yarn 10 around a yarn winding tube 14 while traversing the spun yarn 10, to form a package 15. Hereinafter, the term "package 15" may sometimes refer to a yarn winding tube 14 having a spun yarn 10 wound thereon.

[0045] A blower (not shown) is disposed in the blower box 80. The blower functions as a negative pressure source that provides a negative pressure for sucking yarn debris and the like. The plurality of winder units 1a are connected to a shared blower duct (not shown). The cotton collection box 19 is disposed on one side of the blower box 80. The blower is connected to the blower duct via the cotton collection box 19. Disposed inside the cotton collection box 19 is a known filter member for catching fiber debris and yarn debris. This allows fiber debris and yarn debris emitted from the winder units 1a to be sucked through the duct and stored inside the cotton collection box 19.

[0046] An integrated control device 91 is disposed in the motor box 85. As shown in FIG. 4, the integrated control device 91 is configured to be communicable with unit controllers 95, 95, ... of the respective winder units 1a, 1a, ... The integrated control device 91 is also configured to be communicable with an automatic feed device controller 99 of the automatic bobbin feed device 18 which will be described later.

[0047] In this embodiment, the integrated control device 91, the unit controllers 95, 95, ..., and the automatic feed device controller 99 are combined to serve as a waste yarn emission amount output device 150.

[0048] The integrated control device 91 is able to integrally control information on the respective winder units 1a and the like. The integrated control device 91 includes a display (display unit) 92, an input unit 93, and a main control unit 94, as shown in FIG. 2 and FIG. 4.

[0049] When appropriately operated by an operator, the display 92 displays an operating status of each winder unit 1a and/or information on yarn quality.

[0050] The input unit 93 has a plurality of input keys.

The input unit 93 is used for the operator's selecting which information is to be displayed on the display 92. The input unit 93 receives setting about various operating statuses of each winder unit 1a and/or information on yarn quality as well as setting about operations of various devices in the automatic winder system 100.

[0051] When one of the winder units 1a makes a package 15 fully wound (would with a specified amount of spun yarn 10), the doffing cart 17 shown in FIG. 2 moves to a position corresponding to this winder unit 1a. After arriving at this winder unit 1a, the doffing cart 17 is able to automatically remove the fully wound package 15 and set a new yarn winding tube 14.

[0052] Here, referring to FIG. 2 and FIG. 3, the winder unit 1a will be described in detail. As shown in FIG. 2 and FIG. 3, the winder unit 1a is configured to unwind a spun yarn 10 from a yarn feed bobbin 12 and wind the unwound spun yarn 10 onto a yarn winding tube 14 of a yarn winding part 22 while traversing the spun yarn 10. The yarn winding part 22 includes a cradle 31 and a winding drum 30.

[0053] The cradle 31 is able to rotatably support the yarn winding tube 14 (or the package 15). The cradle 31 is also able to bring a periphery of the package 15 supported thereon into contact with a periphery of the winding drum 30.

[0054] As the winding of the spun yarn 10 onto the yarn winding tube 14 progresses, the diameter of the package 15 increases. The cradle 31 enables the yarn winding tube 14 supported thereon to move away from the winding drum 30. It therefore is possible to continue the winding even though the diameter of the package 15 is increasing.

[0055] The winding drum 30 makes the package 15 rotate while traversing the spun yarn 10 over a surface of the package 15. The winding drum 30 is driven and rotated by an electric motor 63. Driving and rotating the winding drum 30 with the periphery of the package 15 in contact with the winding drum 30 causes slave rotation of the package 15. The winding drum 30 has, on its peripheral surface, a traverse groove with a spiral shape. The traverse groove allows the spun yarn 10 unwound from the yarn feed bobbin 12 to be traversed over a constant width while the spun yarn 10 is being wound onto the surface of the package 15. As a result, the package 15 having a constant winding width can be obtained.

[0056] In this embodiment, a driving force of the electric motor 63 is transferred to the winding drum 30, so that the winding drum 30 causes slave rotation of the yarn winding tube 14 and the package 15. It may also be acceptable that a driving force of the electric motor 63 is transferred directly to the yarn winding tube 14 to cause rotation of the yarn winding tube 14 and the package 15.

[0057] The winder unit 1a includes a bobbin setting part (yarn feed part) 20 that supports the yarn feed bobbin 12, and a yarn winding part (winding part) 22 that winds the spun yarn 10. A travel route for the spun yarn 10 is formed between the bobbin setting part 20 and the yarn

winding part 22. The winder unit 1a has, in the middle of the travel route, an unwinding assist device 23, a lower yarn blow-up part 24, a tension application device 25, a yarn joining device 26, a yarn quality measurement device 27, and a waxing device 36, which are disposed in this order from the bobbin setting part 20 side toward the yarn winding part 22 side.

[0058] The unwinding assist device 23 assists in unwinding the spun yarn 10 from the yarn feed bobbin 12. The unwinding assist device 23 includes a movable member. The movable member is able to come into contact with a balloon which appears in an upper portion of the yarn feed bobbin 12 as a result of the spun yarn 10 unwound from the yarn feed bobbin 12 being swung around. The unwinding assist device 23 changes the position of the movable member, to appropriately control the size of the balloon.

[0059] The lower yarn blow-up part 24 injects compressed air upward. This allows a lower yarn fed from the yarn feed bobbin 12 to be blown up toward the yarn joining device 26.

[0060] The tension application device 25 applies a predetermined tension to the traveling spun yarn 10. The tension application device 25 of this embodiment has a gate type configuration in which a movable comb teeth is disposed against an immovable comb teeth. The movable comb teeth is configured to be rotated by a rotary solenoid so that the comb teeth has a meshed state or an unmeshed state. A tension sensor 37 that measures a tension of the spun yarn 10 is disposed downstream of the tension application device 25.

[0061] The yarn quality measurement device 27 monitors, for example, the thickness of the spun yarn 10, to detect a yarn defect such as a slub. A cutter 39 is disposed near the yarn quality measurement device 27. The cutter 39 cuts the spun yarn 10 immediately when the yarn quality measurement device 27 detects a yarn defect.

[0062] The waxing device 36 waxes the traveling spun yarn 10. A sucking part (not shown) is provided downstream of the waxing device 36. The sucking part, which is connected to an appropriate negative pressure source, is able to suck and remove dregs of the wax, for example.

[0063] When the spun yarn 10 is broken, the yarn joining device 26 joins a lower yarn on the yarn feed bobbin 12 side to an upper yarn on the package 15 side. The breakage of the spun yarn 10 is caused, for example, when the yarn quality measurement device 27 detects a yarn defect and therefore the cutter 39 cuts the spun yarn 10, when the spun yarn 10 unwound from the yarn feed bobbin 12 is disconnected, or when the yarn feed bobbin 12 is replaced. The yarn joining device 26 of this embodiment uses compressed air to join the yarns by, for example, twisting the upper and lower yarns together.

[0064] A lower yarn guide pipe (yarn guide device) 28 and an upper yarn guide pipe 29 are disposed below and above the yarn joining device 26, respectively. The lower yarn guide pipe 28 catches and guides the lower yarn on

the yarn feed bobbin 12 side. The upper yarn guide pipe 29 catches and guides the upper yarn on the package 15 side. The lower yarn guide pipe 28 has a suction port 32 at its distal end, and the upper yarn guide pipe 29 has a suction mouth (suction port) 34 at its distal end. Each of the lower yarn guide pipe 28 and the upper yarn guide pipe 29 is connected to a negative pressure source. Accordingly, suction airflows for catching yarn ends can be generated at the suction port 32 and at the suction mouth 34.

[0065] With this configuration, when the yarn feed bobbin 12 is replaced for example, a lower yarn of a yarn feed bobbin 12 newly supplied is blown up by the lower yarn blow-up part 24. The lower yarn is caught by the suction port 32 of the lower yarn guide pipe 28 which is waiting near the travel route for the spun yarn 10. Then, the lower yarn guide pipe 28 rotates upward about a shaft 33. The lower yarn is accordingly guided to the yarn joining device 26. Almost concurrently with this, the package 15 is driven in reverse rotation so that an upper yarn is unwound. The upper yarn is caught by the suction mouth 34 of the upper yarn guide pipe 29. Then, the upper yarn guide pipe 29 rotates downward about a shaft 35. The upper yarn is accordingly guided to the yarn joining device 26. In the yarn joining device 26, the lower yarn and the upper yarn are joined to each other.

[0066] When the upper yarn and the lower yarn are joined to each other in the yarn joining device 26, an excess of the upper yarn and an excess of the lower yarn are cut and removed. If the upper yarn unwound by the reverse rotation of the package 15 is long, the amount of waste yarn increases. Likewise, if the lower yarn unwound from the yarn feed bobbin 12 is long, the amount of waste yarn increases.

[0067] A yarn defect detected by the yarn quality measurement device 27 sometimes appears only in a short section and sometimes appears over a long section in the longitudinal direction of the spun yarn 10. After the yarn quality measurement device 27 detects a yarn defect and thus the cutter 39 cuts the spun yarn 10, a part of the spun yarn 10 containing the yarn defect is once wound into the package 15 which is rotating by inertia. When the package 15 is driven in reverse rotation, the rotation angle over which the package 15 is driven in reverse rotation is controlled in accordance with the length of the yarn defect, in order that the yarn defect can be entirely drawn out by the upper yarn guide pipe 29 for removal.

[0068] The length over which the lower yarn is sucked by the lower yarn guide pipe 28 at a time of yarn joining is mostly constant, though it can be changed by setting. In this respect, however, in a case where the spun yarn 10 wound on the yarn feed bobbin 12 has a local section where low quality portions concentrate, the cutter 39 frequently cuts the spun yarn 10 in this section. If such a spun yarn 10 was controlled as usual, cutting of the yarn, stopping of the winding, yarn joining, and resuming of the winding should be repeated, which largely deterio-

rates a yarn winding efficiency. In this embodiment, therefore, in a case where the yarn quality measurement device 27 detects a yarn defect and thus the spun yarn 10 is cut with some frequency, the winder unit 1a causes the lower yarn guide pipe 28 to keep sucking the spun yarn 10 from the yarn feed bobbin 12 supported on the bobbin setting part 20 for a longer period than usual. As result, a section of the spun yarn 10 that is likely to contain many defective portions is not fed from the yarn feed bobbin 12 but is removed. Accordingly, the winding efficiency can be improved. In this case, the lower yarn guide pipe 28 sucks a larger amount of waste yarn than usual.

[0069] The above-described configuration enables each winder unit 1a of the automatic winder 1 to unwind a spun yarn 10 from the yarn feed bobbin 12 supported on the bobbin setting part 20 and wound the spun yarn 10 onto the yarn winding tube 14, to form a package 15 having a predetermined length.

[0070] The fine spinning machine 40 shown in FIG. 1 is configured as a ring fine spinning machine that winds a spun yarn 10 onto a bobbin tube 120, the spun yarn 10 having been produced from a roving being drafted and twisted. As a configuration of the ring fine spinning machine is well known, a detailed description thereof is omitted herein.

[0071] The bobbin feed device 3 is configured to set the yarn feed bobbin 12 fed from the fine spinning machine 40 onto the conveyance tray 16 one by one. As a result, the conveyance tray 16 supports the yarn feed bobbin 12 in a substantially upright posture.

[0072] The bobbin feed device 3 is, though not shown, provided with a bobbin individual feed device which is called a parts feeder (not shown), for enabling the yarn feed bobbins 12 to be aligned in a constant posture.

[0073] The yarn feed bobbin 12 which is conveyed in the parts feeder has a bunch winding so that that the spun yarn 10 cannot be unwound therefrom in the course of conveyance, as will be detailed later. The spun yarn 10, however, may be unwound from the yarn feed bobbin 12 due to some cause such as occurrence of breakage of the spun yarn 10 at a bunch winding portion. In view of this, the parts feeder is provided with a cutter for cutting the spun yarn 10 unwound from the yarn feed bobbin 12. This can prevent the spun yarn 10 from being entangled around peripheral members. A waste yarn emitted as a result of cutting by the cutter is sucked by a suction mechanism (not shown). The parts feeder is provided with an air blast for blowing away fiber debris and the like.

[0074] As mentioned above, the yarn feed bobbin 12 is placed on the conveyance tray 16 while being conveyed to the winder unit 1a through the feed passage 4, and the winder unit 1a unwinds the spun yarn 10. The bobbin 13 obtained as a result of the unwinding of the spun yarn 10 remains placed on the conveyance tray 16 while being discharged from the winder unit 1a through the collection passage 5.

[0075] The bobbin preparation system 2 has a conveyance passage 6 through which the conveyance tray 16

is conveyed. The conveyance passage 6 connects the feed passage 4 and the collection passage 5 of the automatic winder 1 to each other.

[0076] To be specific, the conveyance passage 6 includes a feed conveyance passage 6a, a return conveyance passage 6b, a skip passage 6c, and a restoration passage 6d. The feed conveyance passage 6a feeds the yarn feed bobbin 12 to the automatic winder 1. The return conveyance passage 6b returns the bobbin 13 discharged from the automatic winder 1 to the fine spinning machine 40. The skip passage 6c allows the conveyance tray 16 to be conveyed from the feed conveyance passage 6a to the return conveyance passage 6b (not via the winder unit 1a). The restoration passage 6d allows the conveyance tray 16 to be restored from the return conveyance passage 6b to the feed conveyance passage 6a.

[0077] The bobbin preparation system 2 is disposed between the automatic winder 1 and the bobbin feed device 3. The bobbin preparation system 2 includes a bunch unwinding device 7, a suction-type yarn end drawing device 8, a hitch-type yarn end drawing device 8a, and a yarn end preparation device 9. The bobbin preparation system 2 applies an appropriate treatment on the yarn feed bobbin 12 such that the automatic winder 1 can smoothly unwind the spun yarn 10, and then feeds the yarn feed bobbin 12 to the automatic winder 1.

[0078] The bunch unwinding device 7 unwinds the bunch winding of the yarn feed bobbin 12. When the fine spinning machine 40 forms the yarn feed bobbin 12, the fine spinning machine 40 creates a bottom bunch with the spun yarn 10 in a base portion of the bobbin tube 120. This is for preventing a yarn end from coming out during transportation of the yarn feed bobbin 12. The bunch unwinding device 7 unwinds (removes) this bunch, to free the yarn end. The bunch unwinding device 7 includes a bobbin rotation mechanism that rotates a fully wound bobbin 11a, a suction mechanism that sucks a spun yarn 10, and a cutting mechanism that cuts the spun yarn 10.

[0079] The suction-type yarn end drawing device 8 shown in FIG. 1 stimulates a surface of a yarn layer of the yarn feed bobbin 12 with a surface stimulus device, and then sucks and catches a yarn end, to draw out the yarn end from the yarn feed bobbin 12. The suction-type yarn end drawing device 8 also has a suction mechanism. The surface stimulus device may be configured to include, for example, a rubbing member capable of contacting and rubbing the surface of the yarn layer. The suction-type yarn end drawing device 8 includes an air cylinder for bringing the yarn feed bobbin 12 into contact with the rubbing member, and a cutter for cutting a yarn end that has been caught.

[0080] The hitch-type yarn end drawing device 8a hitches a yarn end in an outermost layer of the yarn feed bobbin 12 unwound by the bunch unwinding device 7, to catch the yarn end, and then draws out the yarn end from the yarn feed bobbin 12. The hitch-type yarn end drawing

device 8a draws out the yarn end from the yarn feed bobbin 12 by hitching the yarn end, and blows the yarn end toward the vicinity of a distal end portion of the yarn feed bobbin 12 by means of a compressed air injection nozzle. Then, the yarn feed bobbin 12 is rotated so that a distal end side winding portion can be formed which is similar to that formed by the suction-type yarn end drawing device 8.

[0081] Both the suction-type yarn end drawing device 8 and the hitch-type yarn end drawing device 8a, or only either one of them, may be used to catch the yarn end of the yarn feed bobbin 12.

[0082] The yarn end preparation device 9 processes the yarn end drawn out by the suction-type yarn end drawing device 8 or by the hitch-type yarn end drawing device 8a, for making preparation that enables the automatic winder 1 to smoothly draw out the yarn end from the yarn feed bobbin 12.

[0083] When a yarn feed bobbin 12 having a distal end side winding portion is coming, the yarn end preparation device 9 stretches bellows of a suction tube (not shown) to cover a distal end portion of the yarn feed bobbin 12, and generates a suction airflow in the yarn suction tube to suck the distal end side winding portion of the yarn feed bobbin 12, thereby catching a yarn end.

[0084] After catching the yarn end, the yarn end preparation device 9 contracts the bellows of the yarn suction tube, and then operates a cutter to cut the spun yarn 10. A waste yarn emitted as a result of cutting by the cutter is sucked by a suction mechanism (not shown). Then, a yarn absorber generates a suction airflow in the conveyance tray 16 and in a shaft hole of the bobbin tube 120, to absorb the yarn end through an opening at the upper end of the bobbin tube 120. In this manner, the preparation for putting the yarn end into the bobbin tube 120 from above can be ready.

[0085] With the configuration thus far described, the bobbin preparation system 2 removes a bunch winding of the yarn feed bobbin 12 fed from the bobbin feed device 3. The bobbin preparation system 2 prepares a yarn end of the yarn feed bobbin 12 by drawing out the yarn end from the yarn feed bobbin 12, and then conveys the yarn feed bobbin 12 to the automatic winder 1.

[0086] Each of the winder units 1a (FIG. 2) included in the automatic winder 1 draws out the yarn end prepared by the bobbin preparation system 2, in the above-described manner. Then, the yarn joining device 26 capable of untwisting and connecting the yarn end joins the yarn end to the spun yarn 10 on the package 15 side. Then, the spun yarn 10 is wound onto the yarn winding tube 14, so that the package 15 is obtained.

[0087] The bobbin 13, which was the yarn feed bobbin 12 before unwinding of the spun yarn 10 in each winder unit 1a, is returned to the fine spinning machine 40 via the collection passage 5 and the return conveyance passage 6b.

[0088] The bobbin 13 discharged from each winder unit 1a does not always have to be an empty bobbin 11d (FIG.

1) from which the spun yarn 10 has been entirely unwound. The bobbins 13 discharged from the winder units 1a may include a half yarn bobbin 11b and an extremely small yarn bobbin 11c with some cause. The half yarn bobbin 11b is wound with an amount of yarn that can be wound by the winder unit 1a. The extremely small yarn bobbin 11c is wound with a small amount of yarn that cannot be wound by the winder unit 1a.

[0089] Next, a process concerning the bobbin 13 discharged from the automatic winder 1 will be briefly described.

[0090] In the return conveyance passage 6b through which the bobbin 13 is returned to the fine spinning machine 40, a remaining yarn detection device 45 and a switching device 46 are disposed in this order along the conveyance direction of the bobbin 13. The remaining yarn detection device 45 detects the position of a remaining yarn brush (not shown) which turns along a peripheral surface of the bobbin 13, and based on the detected position of the remaining yarn brush, determines whether or not any spun yarn 10 is wound on the bobbin tube 120. More specifically, the remaining yarn detection device 45 attempts to make the remaining yarn brush turn along the peripheral surface of the bobbin 13 from the distal end portion toward the base portion of the bobbin 13. If the remaining yarn brush is not caught on the peripheral surface of the bobbin 13, the remaining yarn detection device 45 determines that no spun yarn 10 is wound on the bobbin 13. If the remaining yarn brush is caught on the peripheral surface of the bobbin 13, the remaining yarn detection device 45 determines that any spun yarn 10 is wound on the bobbin 13.

[0091] Based on the determination made by the remaining yarn detection device 45, the switching device 46 selectively sends the bobbin 13 to the feed conveyance passage 6a or returns the bobbin 13 to the fine spinning machine 40. As a result, the empty bobbin 11d is returned to the fine spinning machine 40, while a bobbin (the half yarn bobbin 11b and the extremely small yarn bobbin 11c) having a remaining yarn is restored to the feed conveyance passage 6a through the restoration passage 6d.

[0092] Accordingly, if a bobbin 13 collected from the automatic winder 1 is wound with at least a predetermined amount of yarn, the bobbin 13 is conveyed to the bobbin preparation system 2 so that the bobbin 13 can be again subjected to winding in the automatic winder 1.

[0093] In the restoration passage 6d, a yarn amount detection device 47, a second remaining yarn detection device 48, and a remaining yarn processing device 49 are disposed in this order along the conveyance direction of the bobbin 13. The yarn amount detection device 47 brings an arm (not shown) into contact with a bobbin 13 being conveyed, and detects the position of the arm, to thereby detect the amount of yarn wound on the bobbin 13. The second remaining yarn detection device 48, which has a configuration similar to that of the remaining yarn detection device 45, detects whether or not any spun

yarn 10 is left on the bobbin 13.

[0094] If the yarn amount detection device 47 detects a bobbin 13 (extremely small yarn bobbin 11c) having a predetermined amount or less of remaining yarn, the remaining yarn processing device 49 clamps a base portion of a bobbin tube 120 with a clasper (not shown) while holding down an upper portion of the bobbin 13 with an air cylinder. In this state, the clasper is moved in the longitudinal direction of the bobbin tube 120 toward a distal end portion of the bobbin tube 120, so that a yarn wound on the extremely small yarn bobbin 11c is pulled out upward from the distal end portion of the bobbin tube 120. The remaining yarn thus pulled out is collected into the cotton collection box 19 by a suction device (not shown). Removal of the remaining yarn makes the extremely small yarn bobbin 11c turn into an empty bobbin 11d. Thereafter, the empty bobbin 11d is returned to the fine spinning machine 40 through the restoration passage 6d and the skip passage 6c.

[0095] In the automatic winder system 100 having the above-described configuration, waste yarns are emitted from each device. Specific examples are as follows.

[0096] The yarn joining device 26 of the automatic winder 1, when twisting the spun yarn 10, cuts an excess of the upper yarn and an excess of the lower yarn with a cutter (not shown). Consequently, waste yarns are emitted. Unwanted portions of the upper yarn and the lower yarn are sucked by the upper yarn guide pipe 29 and the lower yarn guide pipe 28.

[0097] The bunch unwinding device 7 unwinds a bunch winding of the yarn feed bobbin 12, and cuts the spun yarn 10 at an appropriate portion. A portion of the spun yarn 10 corresponding to the bunch winding becomes a waste yarn. The waste yarn is sucked by the suction mechanism.

[0098] In the suction-type yarn end drawing device 8, the hitch-type yarn end drawing device 8a, and the yarn end preparation device 9, an excess of the spun yarn 10 drawn out from the yarn feed bobbin 12 is cut into an appropriate length with a cutter (not shown). Consequently, a waste yarn is emitted. The waste yarn is sucked by the suction mechanism.

[0099] The remaining yarn processing device 49 pulls out a spun yarn 10 from the extremely small yarn bobbin 11c. The spun yarn 10 pulled out becomes a waste yarn. The waste yarn is sucked by the suction device.

[0100] In this embodiment, as thus far described, the yarn joining device 26 of the automatic winder 1 corresponds to one of the devices emitting waste yarns of the present invention. The bunch unwinding device 7, the suction-type yarn end drawing device 8, the hitch-type yarn end drawing device 8a, the yarn end preparation device 9, and the remaining yarn processing device 49 correspond to ones of the devices emitting waste yarns of the present invention. Waste yarns emitted from various devices flow on a suction airflow, and all of them are collected into the blower box 80.

[0101] Hereinafter, the devices that emit waste yarns

as mentioned above may be collectively referred to as waste yarn emission parts 90, 90 ... FIG. 4 illustrates only a few waste yarn emission parts 90, but actually, there are many waste yarn emission parts 90 as described above. Each of the waste yarn emission parts 90 is operated at a required timing, and waste yarns emitted from them have various lengths.

[0102] The unit controller 95 includes a storage section 95a and a calculation section (output section) 95b.

[0103] To be specific, the unit controller 95 is configured as a known computer. The computer includes a CPU, a ROM, a RAM, and the like. The ROM stores programs for controlling respective parts of the winder unit 1a and for acquiring various information. Cooperation of the above-described hardware and software enables the unit controller 95 to function as the storage section 95a, the calculation section 95b, and the like.

[0104] Upon a yarn joining operation or an operation of replacing the yarn feed bobbin 12, the unit controller 95 acquires a waste yarn emission amount through calculation, and sends the waste yarn emission amount to the integrated control device 91. The calculation of the waste yarn emission amount is performed based on, for example, the angle through which the winding drum 30 has been rotated in the reverse direction for unwinding of the upper yarn from the package 15, and a time period for which the lower yarn guide pipe 28 has been waiting at a later-described sucking position for unwinding of the lower yarn from the yarn feed bobbin 12.

[0105] The automatic bobbin feed device 18 includes the automatic feed device controller 99. The automatic feed device controller 99, like the unit controller 95, is configured as a known computer. The automatic feed device controller 99 includes a storage section 99a and a calculation section 99b. Once the bunch unwinding device 7 or the like is operated, the automatic feed device controller 99 acquires a waste yarn emission amount through calculation, and sends the waste yarn emission amount to the integrated control device 91.

[0106] The integrated control device 91 receives data on the waste yarn emission amounts in the respective devices, from the unit controller 95 and the automatic feed device controller 99, so that the main control unit 94 obtains an aggregate of the data, and the like.

[0107] The main control unit 94 includes an aggregate section 94a.

[0108] The integrated control device 91 is configured as a known computer. The computer includes a CPU, a ROM, a RAM, and the like. The ROM stores programs for enabling the integrated control device 91 to display various information and to receive a setting operation from the operator. Cooperation of the above-described hardware and software enables the main control unit 94 to function as the aggregate section 94a.

[0109] The storage section 95a of the unit controller 95 and the storage section 99a of the automatic feed device controller 99 each store information necessary in calculation for obtaining a waste yarn emission length or

each store a waste yarn emission length per one operation, with respect to each device.

[0110] A yarn joining operation of the winder unit 1a causes waste yarns to be emitted from both the upper yarn and the lower yarn. A waste yarn (first waste yarn) from the upper yarn is generated at a location downstream of a broken portion of the spun yarn 10 in the yarn travel direction. The waste yarn from the upper yarn is sucked by the upper yarn guide pipe 29, and is collected into the cotton collection box 19. A waste yarn (second waste yarn) from the lower yarn is generated at a location upstream of a broken portion of the spun yarn 10 in the yarn travel direction. The waste yarn from the lower yarn is sucked by the lower yarn guide pipe 28, and is collected into the cotton collection box 19.

[0111] With respect to the waste yarn from the upper yarn, a relationship between the angle through which the winding drum 30 is rotated in the reverse direction for unwinding of the upper yarn from the package 15 and a waste yarn emission length is stored in the storage section 95a. More specifically, a yarn detection sensor for detecting that the upper yarn has been unwound from the package 15 and drawn out is disposed at an appropriate position (for example, at the upper yarn guide pipe 29) in the winder unit 1a. For example, an optical sensor may be employed as the yarn detection sensor. To unwind the upper yarn from the package 15 for the purpose of a yarn joining operation, the winding drum 30 is rotated in the reverse direction so that the package 15 is rotated in a direction reverse to the direction in which the package 15 is rotated at a time of winding. While the package 15 is rotated in the reverse direction, the suction mouth 34 sucks a surface of the package 15 so that the upper yarn is drawn out and is sucked into the upper yarn guide pipe 29. Thereby, the upper yarn is caught by the upper yarn guide pipe 29, so that the upper yarn is allowed to be unwound from the package 15. The yarn detection sensor is able to detect this upper yarn. After the upper yarn is detected by the yarn detection sensor, a necessary amount of upper yarn is drawn out from the package 15. Then, the upper yarn guide pipe 29 is rotated downward to guide the upper yarn to the yarn joining device 26. Then, the reverse rotation of the winding drum 30 stops. The angle through which the winding drum 30 is rotated in the reverse direction in a period from when the upper yarn is detected by the yarn detection sensor to when the reverse rotation of the winding drum 30 stops is controlled in accordance with, for example, the length of a yarn defect detected by the yarn quality measurement device 27. Here, the reverse rotation angle means an accumulated angle. For example, when the winding drum 30 is rotated in the reverse direction twice, the reverse rotation angle is 720°. As the accumulated angle through which the winding drum 30 is rotated in the reverse direction increases, the waste yarn emission length caused in the upper yarn increases. The storage section 95a stores this relationship in the form of a table, a formula, or the like. This relationship can be defined through, for

example, an experiment performed in advance, or can be obtained empirically.

[0112] With respect to the waste yarn from the lower yarn, a relationship between a time period for which the lower yarn guide pipe 28 is sucking the lower yarn at a predetermined position and a waste yarn emission length is stored in the storage section 95a. More specifically, to unwind the lower yarn from the yarn feed bobbin 12 for the purpose of a yarn joining operation, the lower yarn guide pipe 28 brings its suction port 32 close to a yarn travel route at a position slightly downstream of the yarn feed bobbin 12, as indicated by the dot and dash line in FIG. 3. The position of the lower yarn guide pipe 28 at this time may hereinafter be referred to as a sucking position. Making the lower yarn guide pipe 28 rest in this state allows the lower yarn unwound from the yarn feed bobbin 12 to be sucked into the lower yarn guide pipe 28 because of a suction airflow. As a result, the lower yarn is caught by the lower yarn guide pipe 28, so that the lower yarn is allowed to be unwound from the yarn feed bobbin 12. A time length for which the lower yarn guide pipe 28 keeps resting at the sucking position is usually fixed, but exceptionally may be longer in order to remove an increased length of the lower yarn, as mentioned above. As the time length for which the lower yarn guide pipe 28 keeps resting at the sucking position increases, a waste yarn emission length caused in the lower yarn increases. The storage section 95a stores this relationship in the form of a table, a formula, or the like. This relationship can be defined through, for example, an experiment performed in advance, or can be obtained empirically, like in the case of the upper yarn.

[0113] It may be also acceptable that the storage section 95a stores an average waste yarn emission amount per one operation of the upper yarn guide pipe 29 and an average waste yarn emission amount per one operation of the lower yarn guide pipe 28 that have been obtained in advance through an experiment or the like.

[0114] Additionally, a relationship between a yarn count (thickness) of the spun yarn 10 and a length of the spun yarn 10 per unit weight is stored in advance in the storage section 95a of the unit controller 95 and in the storage section 99a of the automatic feed device controller 99.

[0115] The calculation section 95b of the unit controller 95 calculates a waste yarn emission amount. To be specific, upon detecting an operation of the waste yarn emission part 90 of the winder unit 1a, the calculation section 95b divides a waste yarn emission length in each device, which is stored in the storage section 95a, by a length per unit weight of the spun yarn 10, to thereby compute a waste yarn emission amount on a weight basis. The unit controller 95 sends the obtained waste yarn emission amount to the integrated control device 91.

[0116] In a case of a yarn joining operation of the winder unit 1a, the calculation section 95b obtains a waste yarn emission length of the upper yarn through calculation using, for example, the angle through which the wind-

ing drum 30 has been rotated in the reverse direction. The calculation section 95b also obtains a waste yarn emission length of the lower yarn through calculation using, for example, a time period for which the lower yarn guide pipe 28 keeps resting at the sucking position.

[0117] The calculation section 99b of the automatic feed device controller 99 calculates a waste yarn emission amount. To be specific, upon detecting an operation of the waste yarn emission part 90 of the automatic bobbin feed device 18, the calculation section 99b divides a waste yarn emission length in each device, which is stored in the storage section 99a, by a length per unit weight of the spun yarn 10, to thereby compute a waste yarn emission amount on a weight basis. The automatic feed device controller 99 sends the obtained waste yarn emission amount to the integrated control device 91.

[0118] The integrated control device 91 accumulates the waste yarn emission amounts received from the unit controller 95 and the automatic feed device controller 99, while separating the amount corresponding to the automatic winder 1 from the amount corresponding to the automatic bobbin feed device 18. The integrated control device 91 stores an accumulated value corresponding to the automatic winder 1 and an accumulated value corresponding to the automatic bobbin feed device 18. Here, in regard to the accumulated value corresponding to the automatic winder 1, an accumulated value of the waste yarn emission amount is calculated for each winder unit 1a.

[0119] As shown in FIG. 5, the main control unit 94 outputs a result of the computation to a waste yarn amount display area 57 of the display 92. The display 92 can display both a waste yarn emission amount from the entire automatic winder system 100 and a waste yarn emission amount from each winder unit 1a, as will be detailed later.

[0120] An exemplary display on the display 92 will now be described in detail with reference to FIG. 5.

[0121] In a display screen of the display 92 shown in FIG. 5, an input information display area 53 including a lot information display field 51 and a time scale selection field 52 is disposed.

[0122] The lot information display field 51 displays a yarn count and a yarn speed of the yarn received.

[0123] The time scale selection field 52 accepts a pull-down operation for setting a time scale. The time scale means the unit of aggregating information to be displayed in a numerical value display area 58 and a graph display area 62 which will be described later. In the example shown in FIG. 5, "Shift" is selected as the time scale. This means that one shift in a shift-work system adopted by a factory serves as the aggregate unit. In a conceivable example, the one shift lasts eight hours.

[0124] Not only one shift but also one day, one hour, or the like can be set as the unit time scale. Once the time scale is selectively switched, the displays in the numerical value display area 58 and the graph display area 62 are automatically changed.

[0125] In the display screen, the numerical value display area 58 and the graph display area 62 are disposed.

[0126] The numerical value display area 58 includes a yield display area 54, a power consumption display area 55, an air consumption display area 56, and the waste yarn amount display area 57.

[0127] In the yield display area 54, a yield of packages 15 produced so far is displayed on the basis of the weight of the spun yarn 10.

[0128] The power consumption display area 55 displays the amount of power consumed so far.

[0129] The air consumption display area 56 displays the amount of compressed air consumed so far. The compressed air consumption can be acquired by an air flow meter installed on a pipe, for example. The compressed air consumption can also be acquired through calculation using a time period for which an electromagnetic valve disposed in a compressed air route is kept opened.

[0130] The waste yarn amount display area 57 displays the amount of waste yarn emitted so far.

[0131] The graph display area 62 includes a unit graph area 60 and a transition graph area 61. In the unit graph area 60, a numerical value of the aforementioned yield, and the like, is displayed in the form of a graph, for each winder unit 1a. In the transition graph area 61, a change of the numerical value over time is displayed in the form of a graph. Which of the yield, the power consumption, the compressed air, and the amount of waste yarn is to be displayed as a numerical value in the form of a graph in the graph display area 62 can be appropriately selected by operating the input unit 93.

[0132] In the unit graph area 60, for example, a winder unit 1a that exhibits a numerical value largely deviated from the average value over the plurality of winder units 1a as a whole can be displayed in a manner different from the others, such as having a different color or a warning mark. This enables a winder unit 1a that emits an extremely larger amount of waste yarn than the others to be noticed by the operator at an early stage, for example.

[0133] The numerical values displayed in the numerical value display area 58 and the graphs displayed in the graph display area 62 change over time. Display contents can be updated at appropriate time intervals (e.g., every minute) during an operation of the automatic winder system 100, for example. Accordingly, information can be displayed almost on a real-time basis. This makes it possible for the operator to notice and deal with a change of the status early.

[0134] In the numerical value display area 58, the yield display area 54, the power consumption display area 55, the air consumption display area 56, and the waste yarn amount display area 57 each display at least the total amount.

[0135] In the waste yarn amount display area 57, the total amount display area 57a displays the total waste yarn emission amount from the entire automatic winder system 100. Disposed below the total amount display

area 57a are particulars display areas 57b, 57c.

[0136] The particulars display area 57b in the upper stage displays a waste yarn emission amount from the automatic winder 1 (that is, from the plurality of winder units 1a as a whole). The total waste yarn emission amount, when displayed, may be divided into a total waste upper yarn emission amount and a total waste lower yarn emission amount from the automatic winder 1, though not shown in FIG. 5. Such an itemized display can be achieved by: the calculation section 95b of the unit controller 95 calculating a waste upper yarn emission amount and a waste lower yarn emission amount separately from each other; and the unit controller 95 sending the respective waste yarn emission amounts thus calculated to the integrated control device 91.

[0137] The particulars display area 57c in the lower stage displays a waste yarn emission amount from the bobbin preparation system 2 and/or the bobbin feed device 3.

[0138] On the display 92, at least two of the compressed air consumption, the power consumption, and the waste yarn emission amount can be juxtaposed in one screen, or one of them can be displayed solely.

[0139] The waste yarn emission amount output device 150 of this embodiment is able to acquire a waste yarn emission amount through calculation based on stored information, and display the waste yarn emission amount on the display 92. Accordingly, information that is useful in terms of an environmental load and an effective use of resources can be obtained easily. Moreover, information on the waste yarn emission amount can be obtained without the need for actual measurement of a waste yarn weight and the like. Thus, complication of the configuration can be prevented.

[0140] In this embodiment, the waste yarn emission amount output device 150 obtains a waste yarn emission amount through calculation, and therefore merely a simple application is needed to execute simulation calculation.

[0141] For example, there can be a case where a fault discrimination threshold for the yarn quality measurement device 27 is changed. As a standard of fault discrimination for the spun yarn 10 is stricter, the number of times the spun yarn 10 is cut with the cutter 39 increases, so that the number of times yarn joining is performed increases, too. It can therefore be estimated that a waste yarn emission amount from the yarn joining device 26 will increase. The waste yarn emission amount output device 150 can simulate a waste yarn emission amount that would be caused if the fault discrimination threshold for the yarn quality measurement device 27 is changed, and can display a resulting value.

[0142] FIG. 6 shows a case where the strictness of the fault discrimination threshold for the yarn quality measurement device 27 is increased stepwise. The operator appropriately operates the input unit 93 and changes a set value, while seeing displaying on the display 92. After receiving a set value and before actually changing the

setting, the waste yarn emission amount output device 150 can estimate a waste yarn emission amount that would be caused if the setting is changed, and display a resulting value. Calculation for the estimate may be performed either by the calculation section 95b of the unit controller 95 or by a calculation section (not shown) included in the integrated control device 91. This simulation display enables the operator to confirm the likelihood that a waste yarn emission amount will vary, and determine whether to fix the change or to reconsider.

[0143] The simulation described above can be performed by using a known formula if, for example, the frequency at which yarn cutting occurs per one hour and the average yarn defect length are recorded in association with each strictness of the fault discrimination threshold.

[0144] The waste yarn emission amount output device 150 is able to execute simulation calculation for a yarn debris emission amount, in relation to setting on an operation of the upper yarn guide pipe 29 as well.

[0145] The setting on the upper yarn guide pipe 29 may include a standby period from when the yarn detection sensor mentioned above detects the upper yarn to when the upper yarn guide pipe 29 starts rotating downward at a time of the yarn joining operation. When the standby period is long, reliable catching of the upper yarn can be expected, but a waste yarn emission amount is large because the upper yarn is kept sucked into the upper yarn guide pipe 29 for a long time. When the standby period is short, a waste yarn emission amount is small. Simulating an influence on the waste yarn emission amount at a time of setting the standby period enables the operator to make appropriate setting.

[0146] In changing the setting such as a yarn count or a yarn speed, the waste yarn emission amount output device 150 is also able to execute simulation calculation to obtain how much waste yarn emission amount would be caused under conditions after the change, and display an obtained result on the display 92.

[0147] In this manner, this embodiment enables the operator to confirm the current waste yarn emission amount, and to easily consider how waste yarn emission would be influenced under various conditions. Accordingly, it is possible to operate the automatic winder system 100 with the waste yarn emission amount taken into account.

[0148] As thus far described, the waste yarn emission amount output device 150 of this embodiment includes the calculation section 95b and the display 92. The calculation section 95b calculates and outputs a waste yarn emission amount from each of devices in the automatic winder 1, the devices emitting waste yarns. The display 92 displays a waste yarn emission amount outputted by the calculation section 95b.

[0149] Based on what is displayed on the display 92, the operator can easily obtain information that is useful in terms of an environmental load, an effective use of resources, and the like. Moreover, the operator can ob-

tain information on a waste yarn emission amount without the need to actually measure a waste yarn weight and the like. Accordingly, a simple configuration can be achieved.

[0150] In this embodiment, the automatic winder 1 includes the bobbin setting part 20, the yarn winding part 22, and the yarn joining device 26. The spun yarn 10 is drawn out from the bobbin setting part 20. The yarn winding part 22 winds the spun yarn 10 fed from the bobbin setting part 20, to form the package 15. The yarn joining device 26 performs yarn joining when the spun yarn 10 is broken at a location between the bobbin setting part 20 and the yarn winding part 22. The yarn winding part 22 includes the winding drum 30 that comes into contact with the package 15 to cause slave rotation of the package 15. When the yarn joining device 26 performs yarn joining, the calculation section 95b of the waste yarn emission amount output device 150 calculates a waste yarn emission amount based on a rotation angle through which the winding drum 30 is rotated in a direction reverse to a direction in which the winding drum 30 is rotated in order to draw out the spun yarn 10 from the yarn winding part 22 at a time of winding.

[0151] With this configuration, the waste yarn emission amount is calculated in accordance with how much the spun yarn 10 is unwound from the package 15 at a time of yarn joining, and therefore the waste yarn emission amount can be obtained accurately.

[0152] Here, it may be conceivable that the yarn winding part 22 of the winder unit 1a is configured to have rotation of an electric motor or the like directly transferred to the package 15 to wind the spun yarn 10, instead of having the winding drum 30 drive and rub the peripheral surface of the package 15. With such a configuration, the calculation section 95b of the waste yarn emission amount output device 150 can calculate a waste yarn emission amount based on the outer diameter of the package 15 as well as the rotation angle (accumulated angle) through which the package 15 is rotated in the direction reverse to the direction in which the package 15 is rotated at a time of winding.

[0153] In this case as well, the waste yarn emission amount is calculated in accordance with how much the spun yarn 10 is unwound from the package 15 at a time of yarn joining, and therefore the waste yarn emission amount can be obtained accurately.

[0154] In this embodiment, the automatic winder 1 includes the bobbin setting part 20, the yarn winding part 22, the yarn joining device 26, and the lower yarn guide pipe 28. The spun yarn 10 is drawn out from the bobbin setting part 20. The yarn winding part 22 winds the spun yarn 10 fed from the bobbin setting part 20, to form the package 15. The yarn joining device 26 performs yarn joining when the spun yarn 10 is broken at a location between the bobbin setting part 20 and the yarn winding part 22. The yarn guide device sucks and catches the spun yarn 10 unwound from the bobbin setting part 20, and guides the spun yarn 10 to the yarn joining device

26. When the yarn joining device 26 performs yarn joining, the calculation section 95b of the waste yarn emission amount output device 150 calculates a waste yarn emission amount based on a time length for which the lower yarn guide pipe 28 keeps sucking the spun yarn 10.

[0155] Since the waste yarn emission amount is calculated in accordance with how much the spun yarn 10 is unwound from the bobbin setting part 20 at a time of yarn joining, the waste yarn emission amount can be obtained accurately.

[0156] It may also be acceptable that the calculation section 95b calculates a waste yarn emission amount based on the number of times the lower yarn guide pipe 28 is operated.

[0157] Since the waste yarn emission amount is calculated in accordance with how much the lower yarn guide pipe 28 is operated, the waste yarn emission amount can be obtained accurately.

[0158] In the waste yarn emission amount output device 150 of this embodiment, displaying of a waste yarn emission amount on the display 92 is updated while the automatic winder 1 is operating.

[0159] Accordingly, promptness of the displaying can be obtained easily. Thus, even when a waste yarn emission amount has an unusual status during an operation of the automatic winder 1, it is easy to deal with the status at an early stage.

[0160] In the waste yarn emission amount output device 150 of this embodiment, setting on an operation of the devices that emit waste yarns is changeable. In changing the setting, a simulation calculation result indicating a waste yarn emission amount that would be caused by the change is displayed on the display 92.

[0161] Accordingly, when the operator makes setting, the operator can refer to how the waste yarn emission amount will be influenced in advance.

[0162] In the waste yarn emission amount output device 150 of this embodiment, the display 92 simultaneously displays not only the waste yarn emission amount but also at least either of the power consumption in the automatic winder 1 and the compressed air consumption in the automatic winder 1.

[0163] This can enhance completeness of information, allowing an overall status of the automatic winder 1 to be grasped easily.

[0164] In the waste yarn emission amount output device 150 of this embodiment, the automatic winder 1 includes a plurality of winder units 1a that wind the spun yarns 10. Each of the winder units 1a is provided with at least one device that emits a waste yarn. Here, it may be acceptable that a textile machine such as the automatic winder 1 includes one winder unit 1a or the like.

[0165] This configuration enables a waste yarn emission amount from the automatic winder 1 to be grasped easily, even if there are many devices that emit waste yarns.

[0166] In the waste yarn emission amount output device 150 of this embodiment, the display 92 is capable

of displaying a total waste yarn emission amount from the plurality of winder units 1a.

[0167] This makes it possible that the total waste yarn emission amount from the plurality of winder units 1a is compared with a waste yarn emission amount from another part, for examination.

[0168] In this embodiment, when the spun yarn 10 is broken in each winder unit 1a, a waste yarn from the upper yarn is emitted at a location downstream of a broken portion in the yarn travel direction, and a waste yarn from the lower yarn is emitted at a location upstream of the broken portion in the yarn travel direction. The display 92 of the waste yarn emission amount output device 150 is capable of displaying a waste yarn emission amount of the upper yarn and a waste yarn emission amount of the lower yarn from the plurality of winder units 1a as a whole.

[0169] This enables a tendency of emission of waste yarns to be grasped in detail.

[0170] The automatic winder 1 of this embodiment includes the waste yarn emission amount output device 150.

[0171] Accordingly, an operation with a reduction of waste yarns taken into account can be achieved easily.

[0172] Although a preferred embodiment of the present invention has been described above, the configuration above can be modified, for example, as follows.

[0173] Displaying on the display 92 is not limited to the example shown in FIG. 5, and what is displayed thereon, a layout thereof, and the like can be changed appropriately.

[0174] Although the automatic winder 1 described above is configured to have the yarn feed bobbin 12 automatically set, this configuration is not limitative. Alternatively, the operator may set the yarn feed bobbin 12 to the winder unit 1a by hand. In this case, the automatic bobbin feed device 18 may be omitted, and the automatic winder 1 can be operated solely. In such a configuration, the waste yarn emission amount output device is constituted by a combination of the integrated control device 91 with the unit controllers 95.

[0175] The integrated control device 91 can either output obtained information on a waste yarn emission amount to another computer that is in network connection with the integrated control device 91, or output the obtained information by printing it with a printer.

[0176] The waste yarn emission amount output device 150 may be configured to acquire and display the amount of emitted waste yarn, for various purposes and in various ways other than the ones illustrated in the embodiment above.

[0177] In the embodiment described above, the calculation section 95b of each unit controller 95 calculates a waste yarn emission amount from the corresponding winder unit 1a. Likewise, the calculation section 99b of the automatic feed device controller 99 calculates a waste yarn emission amount from the automatic bobbin feed device 18. These calculations, however, may be

implemented by a calculation section included in the integrated control device 91 (main control unit 94). In such a case, the integrated control device 91 serves as the waste yarn emission amount output device.

[0178] In the embodiment described above, a result of calculating a waste yarn emission amount is displayed on the display included in the integrated control device 91. Alternatively, it may be acceptable that the winder unit 1a and the automatic bobbin feed device 18 have display units which display a result of calculating a waste yarn emission amount. In such a configuration, the waste yarn emission amount output device is included in each of the winder units 1a and in the automatic bobbin feed device 18. A simulation calculation and displaying a result thereof, which are involved in changing the strictness of the fault discrimination threshold for the yarn quality measurement device 27 for example, may be implemented by the winder unit 1a and the automatic bobbin feed device 18.

[0179] The present invention is widely applicable to various types of textile machines (e.g., a spinning machine) that handle yarns. Application of the present invention to the automatic winder 1 is especially effective, because the automatic winder 1 performs a yarn joining process more frequently than other textile machines.

Claims

1. A waste yarn emission amount output device comprising:

an output section that calculates and outputs a waste yarn emission amount from each of devices in a textile machine, the devices emitting waste yarns; and
a display unit that displays a waste yarn emission amount outputted by the output section.

2. The waste yarn emission amount output device according to claim 1, wherein:

the textile machine includes

a yarn feed part from which a yarn is drawn out,
a winding part that winds a yarn fed from the yarn feed part, to form a package, and
a yarn joining device that performs yarn joining when a yarn is broken at a location between the yarn feed part and the winding part;

the winding part includes a winding drum that comes into contact with the package to cause slave rotation of the package; and
when the yarn joining device performs yarn joining, the output section calculates a waste yarn

emission amount based on a rotation angle through which the winding drum is rotated in a direction reverse to a direction in which the winding drum is rotated in order to draw out a yarn from the winding part at a time of winding.

3. The waste yarn emission amount output device according to claim 1, wherein:

the textile machine includes

a yarn feed part from which a yarn is drawn out,
a winding part that winds a yarn fed from the yarn feed part, to form a package, and
a yarn joining device that performs yarn joining when a yarn is broken at a location between the yarn feed part and the winding part; and

when the yarn joining device performs yarn joining, the output section calculates a waste yarn emission amount based on a rotation angle through which the package is rotated in a direction reverse to a direction in which the package is rotated in order to draw out a yarn from the winding part at a time of winding.

4. The waste yarn emission amount output device according to any one of claims 1 to 3, wherein:

the textile machine includes

a yarn feed part from which a yarn is drawn out,
a winding part that winds a yarn fed from the yarn feed part, to form a package,
a yarn joining device that performs yarn joining when a yarn is broken at a location between the yarn feed part and the winding part, and
a yarn guide device that sucks and catches a yarn unwound from the yarn feed part, and guides the yarn to the yarn joining device; and

when the yarn joining device performs yarn joining, the output section calculates a waste yarn emission amount based on a time length for which the yarn guide device keeps sucking the yarn.

5. The waste yarn emission amount output device according to any one of claims 1 to 3, wherein:

the textile machine includes

a yarn feed part from which a yarn is drawn

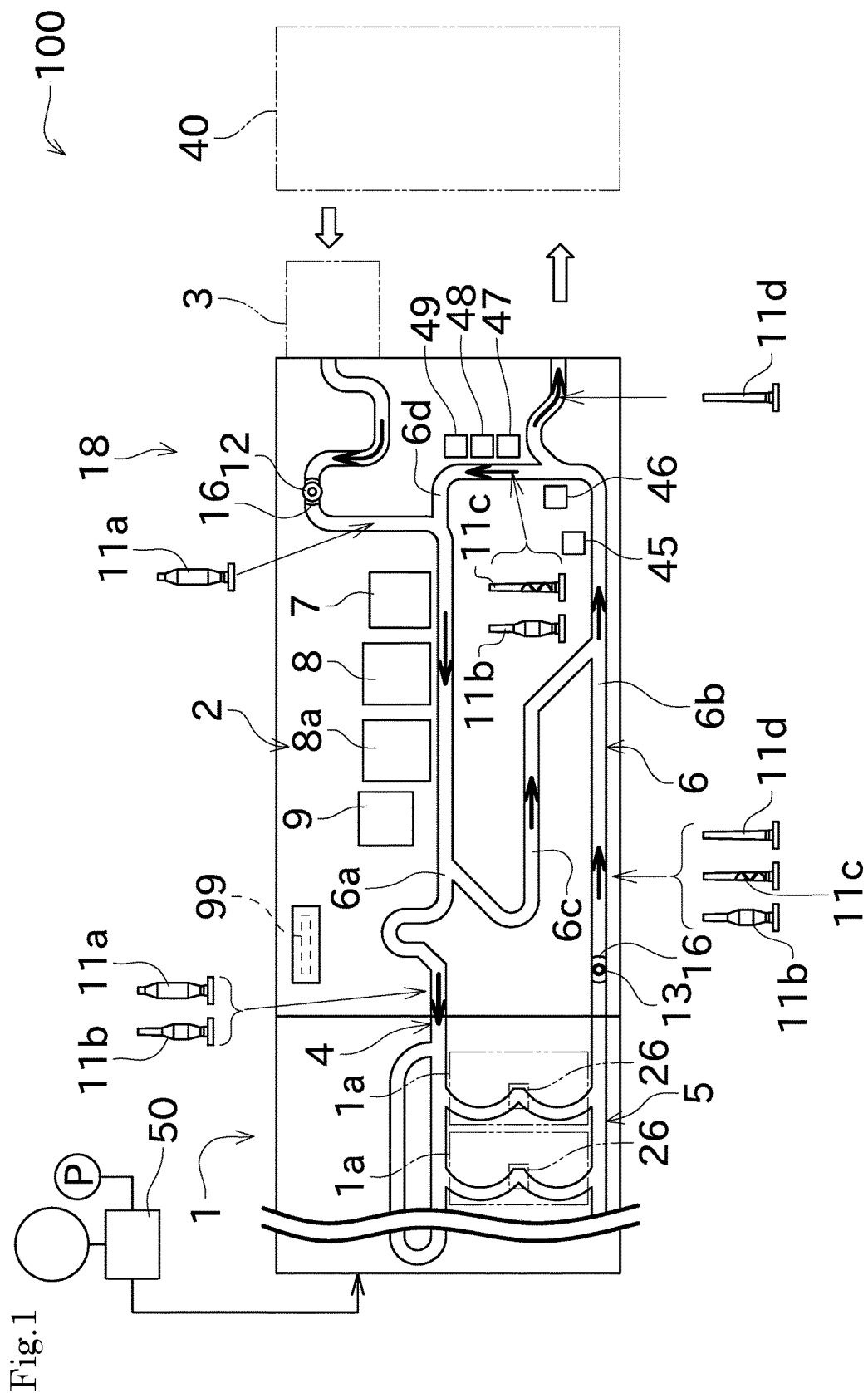
out,
 a winding part that winds a yarn fed from
 the yarn feed part, to form a package,
 a yarn joining device that performs yarn join- 5
 ing when a yarn is broken at a location be-
 tween the yarn feed part and the winding
 part, and
 a yarn guide device that sucks and catches
 a yarn unwound from the yarn feed part, and
 guides the yarn to the yarn joining device; 10
 and

when the yarn joining device performs yarn join-
 ing, the output section calculates a waste yarn
 emission amount based on the number of times 15
 the yarn guide device is operated.

6. The waste yarn emission amount output device ac-
 cording to any one of claims 1 to 5, wherein
 displaying of a waste yarn emission amount on the 20
 display unit is updated while the textile machine is
 operating.
7. The waste yarn emission amount output device ac-
 cording to any one of claims 1 to 6, wherein 25
 setting on an operation of the devices that emit waste
 yarns is changeable, and
 in changing the setting, a simulation calculation re-
 sult indicating a waste yarn emission amount that
 would be caused by the change is displayed on the 30
 display unit.
8. The waste yarn emission amount output device ac-
 cording to any one of claims 1 to 7, wherein 35
 the display unit simultaneously displays not only the
 waste yarn emission amount but also at least either
 of power consumption in the textile machine or com-
 pressed air consumption in the textile machine.
9. The waste yarn emission amount output device ac- 40
 cording to any one of claims 1 to 8, wherein
 the textile machine includes a plurality of winding
 units that wind yarns, and
 each of the winding units is provided with at least
 one device that emits a waste yarn. 45
10. The waste yarn emission amount output device ac-
 cording to claim 9, wherein
 the display unit is capable of displaying a total waste
 yarn emission amount from the plurality of winding 50
 units.
11. The waste yarn emission amount output device ac-
 cording to claim 9 or 10, wherein 55
 the display unit is capable of displaying the emission
 amount of a first waste yarn and the emission amount
 of a second waste yarn from the plurality of winding
 units as a whole, where the first and second waste

yarns represent waste yarns emitted at locations re-
 spectively downstream and upstream of a yarn bro-
 ken portion in each winding unit with respect to a
 yarn travel direction.

12. A textile machine comprising the waste yarn emis-
 sion amount output device according to any one of
 claims 1 to 11.



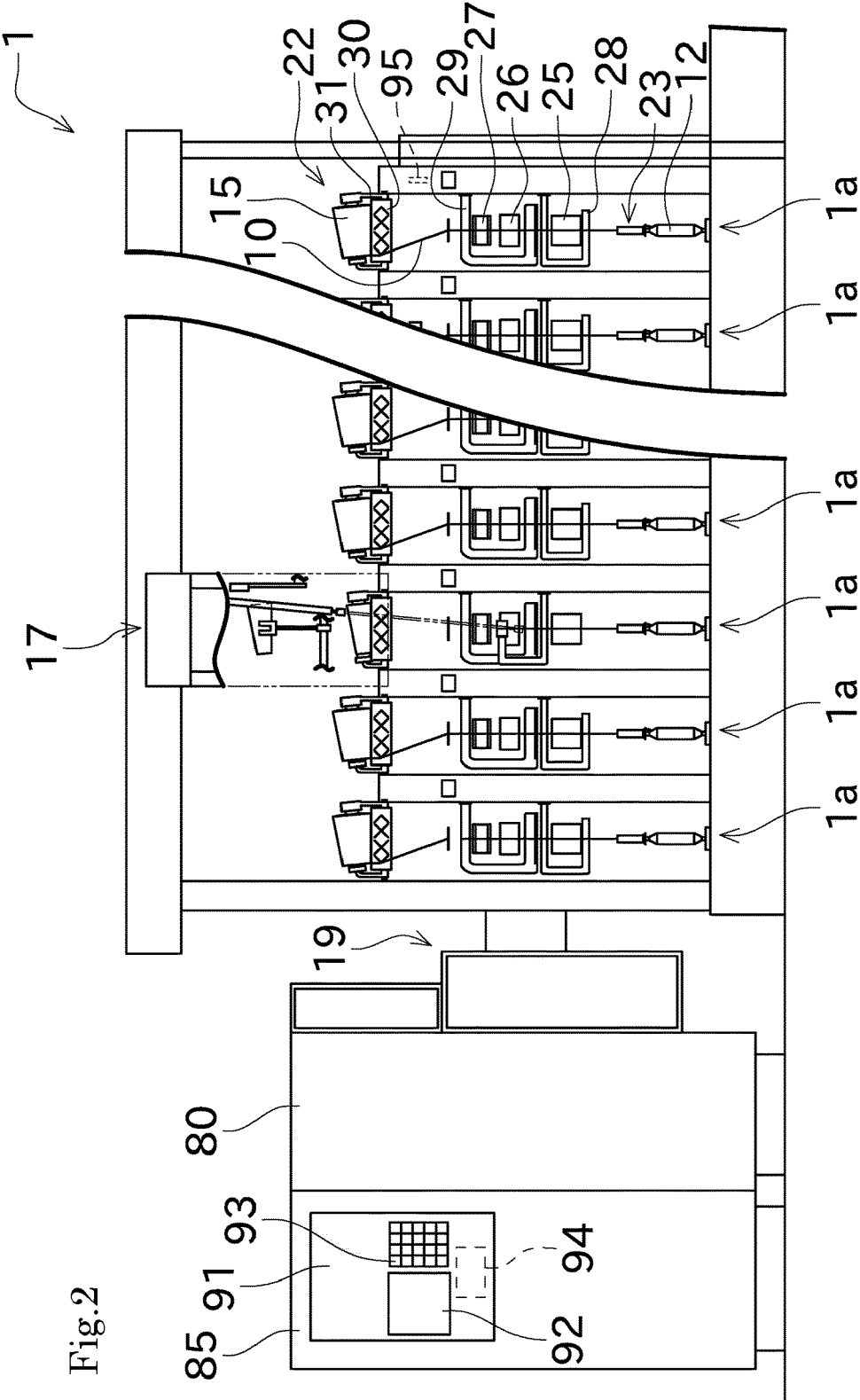


Fig.3

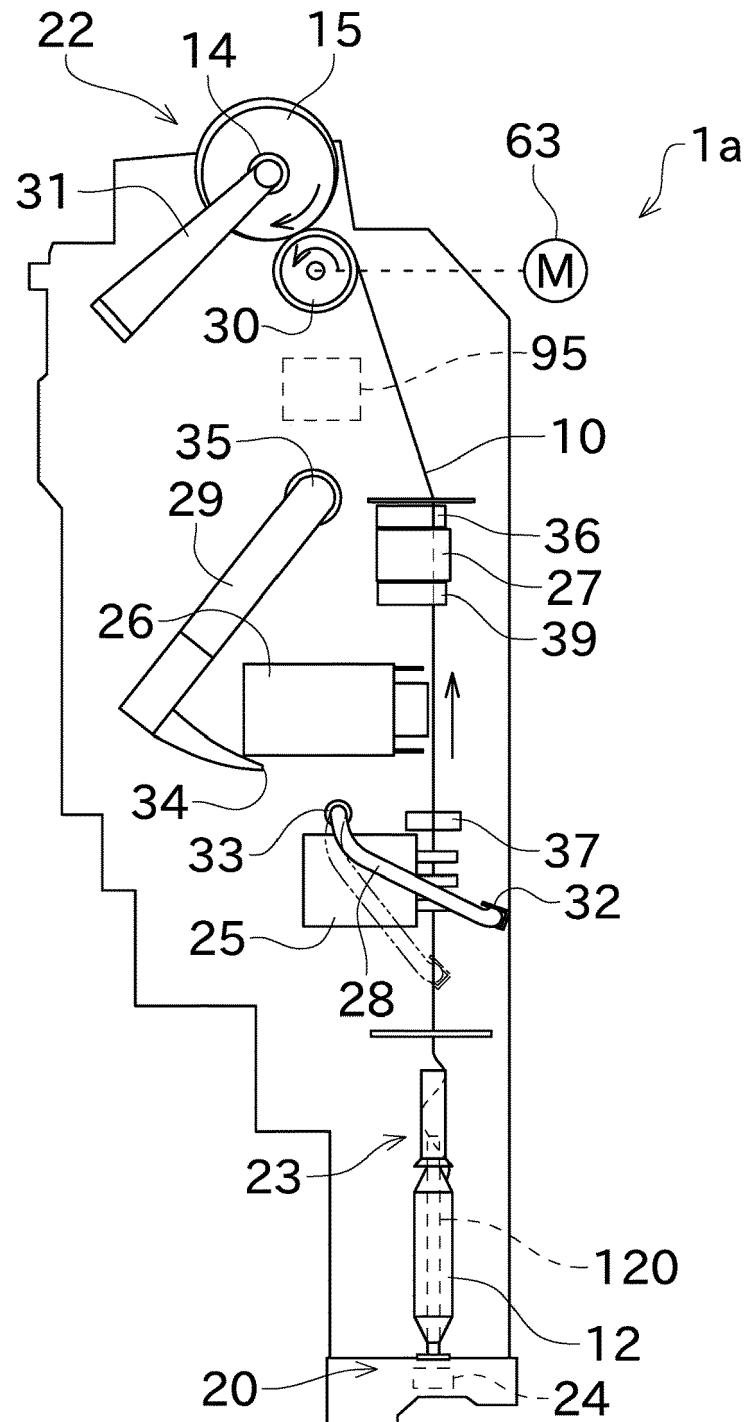
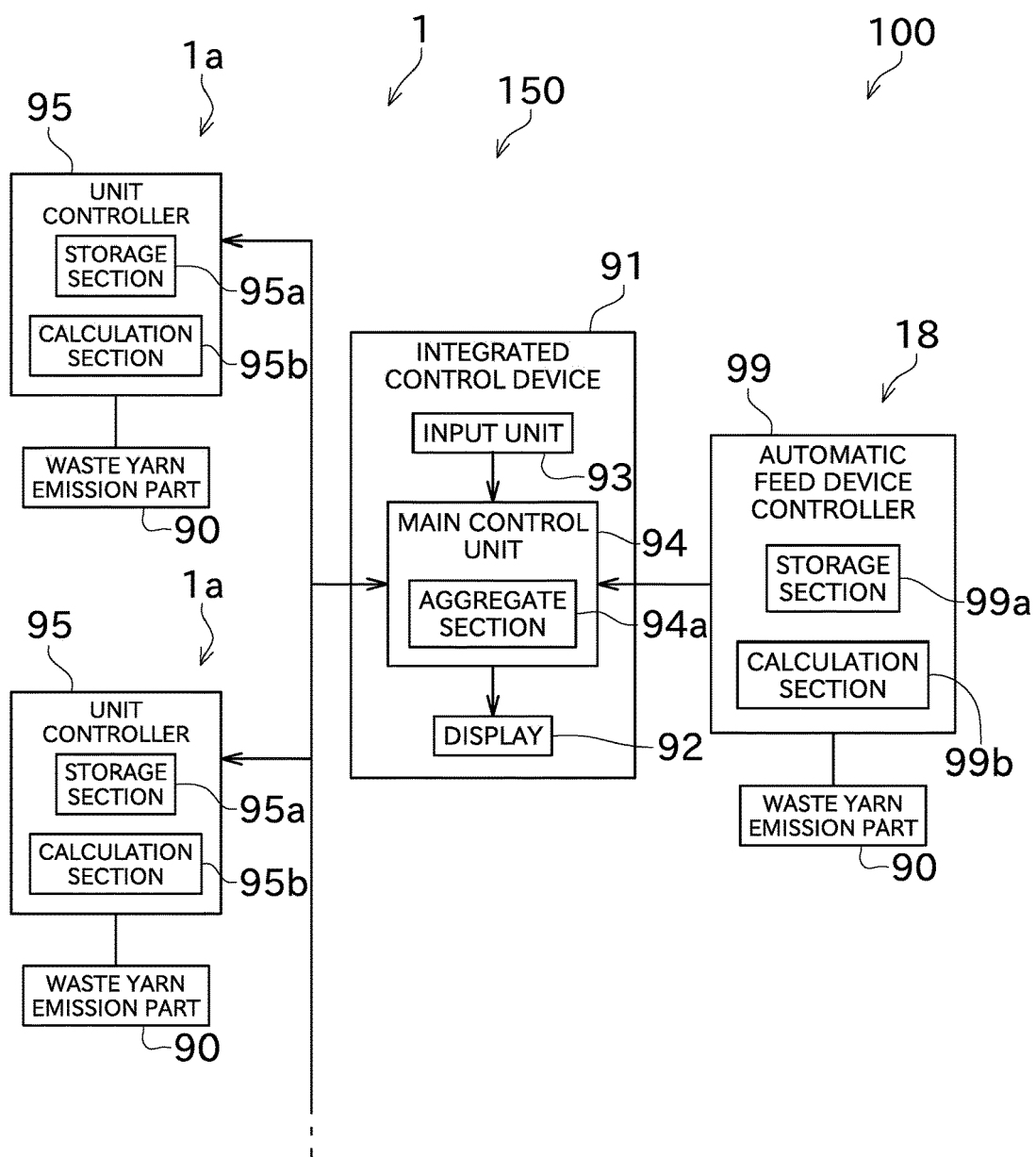


Fig.4



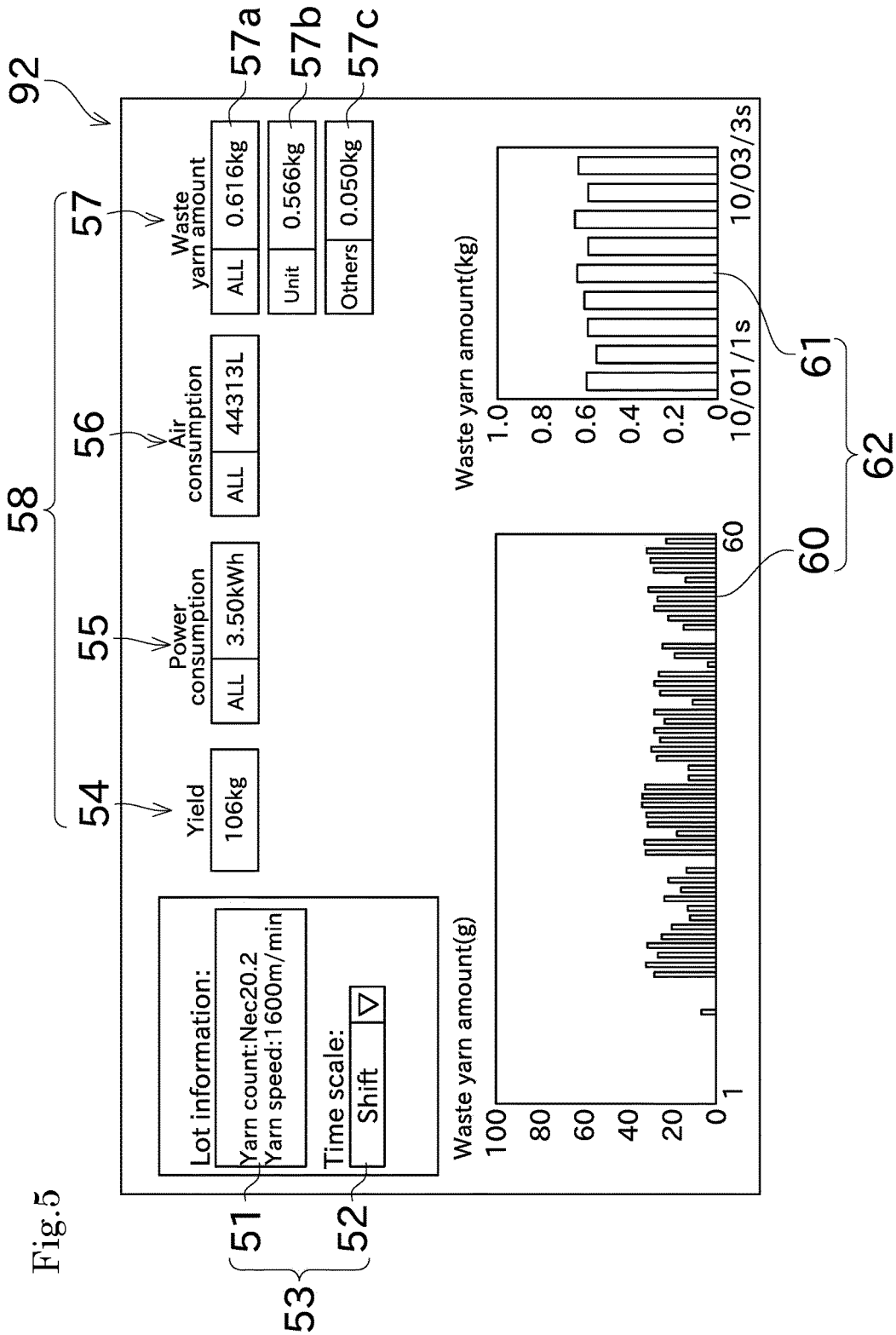


Fig.6

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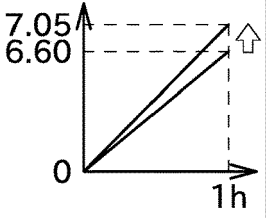
Change yarn defect detection threshold

Strictness: 1 (lower) to 10 (Higher)

Current value: 4

Selected value:

Waste yarn emission amount is estimated to increase by about 0.450 kg per hour.





EUROPEAN SEARCH REPORT

Application Number
EP 20 16 0620

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			TECHNICAL FIELDS SEARCHED (IPC)
			B65H D01H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 June 2020	Examiner Pussemier, Bart
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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