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(72) Inventors:
• **Kasuga, Teruyuki**
Kyoto, 612-8686 (JP)
• **Torii, Ryuta**
Kyoto, 612-8686 (JP)
• **Hirai, Katsuhisa**
Kyoto, 612-8686 (JP)

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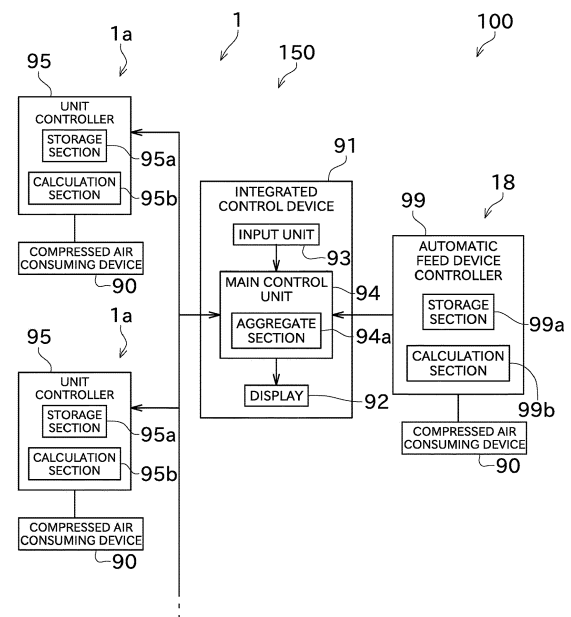
(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(71) Applicant: **Murata Machinery, Ltd.**
Kyoto-shi,
Kyoto 601-8326 (JP)

(54) **COMPRESSED AIR CONSUMPTION OUTPUT DEVICE AND AUTOMATIC WINDER**

(57) A compressed air consumption output device 150 outputs compressed air consumption of an automatic winder 1. The automatic winder 1 includes a plurality of compressed air consuming devices and a plurality of winding units 1a that wind spun yarns 10. The compressed air consumption output device 150 includes a storage section 95a, an output section 95b, and a display unit 92. The storage section 95b stores compressed air consumption per multiplication unit while each of the compressed air consuming devices uses compressed air. The calculation section 95b calculates and outputs the compressed air consumption by multiplication using the compressed air consumption per multiplication unit for each of the compressed air consuming devices. The display 92 displays compressed air consumption 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 compressed air consumption of an automatic winder.

2. Description of the Related Art

[0002] Generally, compressed air is supplied to a textile machine such as the automatic winder, a configuration of the textile machine works by the compressed air.

[0003] For example, in a yarn joining device for joining disconnected yarns, a swirling airflow generates by a compressed air. The yarn joining device untwists yarns and joins the yarns by using the swirling airflow. For another example, a textile machine removes fiber waste by using air blast (blow of compressed air) and drives some configurations by driving an air cylinder.

[0004] JP2009-102132A discloses a method of controlling blower motor and a control system for controlling increase and decrease of a rotation rate of the blower based on probability of false of a yarn joining operation, the blower supplying negative pressure required to a yarn joining operation. In JP2009-102132A, it is a premise that air consumption increases when the yarn joining operation fails. JP2009-102132A discloses that the rotation rate for driving the blower is efficiently suppressed while supplying the minimum negative pressure required to the yarn joining operation.

SUMMARY OF THE INVENTION

[0005] In the textile machine as disclosed in JP2009-102132A, information about compressed air consumption is important from the viewpoint of operation efficiency and the like. In this respect, however, JP2009-102132A do not provide a configuration that enables the compressed air consumption to be grasped quantitatively.

[0006] In order to obtain compressed air consumption, it is conceivable to attach an air flowmeter for measuring the flow rate of the compressed air to a pipe or the like. However, when there are many devices that consume the compressed air and many pipes, many air flowmeters must be installed, which causes an increase in cost. Air flowmeters usually have a large measurement error and are prone to failure when the quality of the air is poor. Therefore, it is difficult to use the air flowmeter as a monitor, and there is room for improvement.

[0007] The present invention has been accomplished in view of such circumstances, and aims to grasp the compressed air consumption of an automatic winder with a simple configuration.

[0008] The foregoing has described problems to be

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

[0009] In view of a first aspect of the present invention, provided is a compressed air consumption output device including the following features. The compressed air consumption output device outputs compressed air consumption of an automatic winder. The automatic winder includes a plurality of compressed air consuming devices and a plurality of winding units that wind yarns. The compressed air consumption output device includes a storage section, an output section, and a display unit. The storage section stores the compressed air consumption per multiplication unit while each of the compressed air consuming devices uses compressed air. The output section calculates and outputs the compressed air consumption by multiplication using the compressed air consumption per multiplication unit for each of the compressed air consuming devices. The display unit displays compressed air consumption outputted by the output section.

[0010] Accordingly, since the compressed air consumption of the automatic winder can be displayed, an operator can easily examine the operation of the automatic winder in consideration of energy saving and the like. Further, since it is unnecessary to provide an air flowmeter for measuring a flow rate of compressed air in a pipe or the like, it is possible to reduce the cost and prevent an increase in maintenance labor. Moreover, the compressed air consumption can be easily grasped for the automatic winder including a plurality of the compressed air consuming devices.

[0011] The above-described compressed air consumption output device may have the following features.

The storage section stores the compressed air consumption per multiplication unit time of each of the compressed air consuming devices. The output section obtains the compressed air consumption by multiplication using the compressed air consumption per multiplication unit time of the compressed air consuming devices.

[0012] In this case, the compressed air consumption can be easily obtained based on the time during which the compressed air consuming device consumes the compressed air.

[0013] The above-described compressed air consumption output device may have the following features. The storage section stores the compressed air consumption per multiplication unit operation number of each of the compressed air consuming devices. The output section obtains the compressed air consumption by multiplication using the compressed air consumption per multiplication unit operation number of the compressed air consuming devices.

[0014] In this case, the compressed air consumption can be easily obtained based on the number of the operation of the compressed air consuming device.

[0015] The above-described compressed air consumption output device preferably has the following fea-

tures. The output section can switch between a first calculation mode and a second calculation mode. In the first calculation mode, the output section obtains the compressed air consumption by multiplication using the compressed air consumption per multiplication unit time of the compressed air consuming devices. In the second calculation mode, the output section obtains the compressed air consumption by multiplication using the compressed air consumption per multiplication unit operation number of the compressed air consuming devices.

[0016] With this configuration, the compressed air consumption can be obtained in an appropriate manner depending on the situation.

[0017] In the compressed air consumption output device, it is preferable that displaying of compressed air consumption on the display unit is updated while the automatic winder is operating.

[0018] Accordingly, promptness of the displaying can be obtained easily. Thus, even when compressed air consumption has an unusual status during an operation of the automatic winder, it is easy to deal with the status at an early stage.

[0019] The above-described compressed air consumption output device preferably has the following features. The compressed air consumption output device is configured such that setting on consuming the compressed air of the compressed air consuming device is changeable. In changing the setting, a simulation calculation result indicating compressed air consumption that would be caused by the change is displayed on the display unit.

[0020] Accordingly, when the operator makes setting, the operator can refer to how the compressed air consumption will be influenced in advance.

[0021] In the compressed air consumption output device, it is preferable that the display unit simultaneously displays not only the compressed air consumption but also at least either of power consumption in the automatic winder or waste yarn emission amount in the automatic winder.

[0022] This can enhance completeness of information, allowing an overall status of the automatic winder to be grasped easily.

[0023] In the compressed air consumption output device, it is preferable that the display unit is capable of displaying total compressed air consumption of the plurality of winding units.

[0024] This makes it possible for the operator to compare the total compressed air consumption of the plurality of winding units with compressed air consumption of another part, for examination.

[0025] The above-described compressed air consumption output device preferably has the following features. The automatic winder can replace a first compressed air consuming device and a second compressed air consuming device. The storage section stores compressed air consumption per multiplication unit of the first compressed air consuming device and compressed air

consumption per multiplication unit of the second compressed air consuming device. The output section determines which of the first compressed air consuming device and the second compressed air consuming device is attached to the automatic winder, and calculates the compressed air consumption according to the determination result.

[0026] Accordingly, the output section can calculate the compressed air consumption even when either the first compressed air consuming device or the second compressed air consuming device is attached.

[0027] A second aspect of the present invention provides an automatic winder including the compressed air consumption output device.

[0028] Accordingly, efficient use of the compressed air can be achieved easily.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

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 compressed air consumption is displayed in accordance with a change of setting.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0030] 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.

[0031] The automatic winder system 100 shown in FIG. 1 includes the automatic winder 1, a bobbin preparation system 2, and a bobbin feed device 3. The bobbin preparation system 2 and the bobbin feed device 3 constitute an automatic bobbin feed device 18.

[0032] 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.

[0033] The automatic winder system 100 implements removal of fiber waste 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.

[0034] 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.

[0035] 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.

[0036] 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.

[0037] Each winder unit 1a shown in FIG. 2 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.

[0038] A blower (not shown) is disposed in the blower box 80. The blower functions as a negative pressure source that provides a negative pressure. 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 waste and yarn waste. This allows fiber waste and yarn waste emitted from the winder units 1a to be sucked through the duct and stored inside the cotton collection box 19.

[0039] 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.

[0040] 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 compressed air consumption output device 150.

[0041] 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.

[0042] When appropriately operated by an operator, the display 92 displays an operating status of each winder unit 1a and/or information on yarn quality.

[0043] 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 conditions such as a blast time of the air blast and the like in the automatic winder system 100.

[0044] 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.

[0045] 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.

[0046] 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.

[0047] 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.

[0048] 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 a non-illustrated drive source (electric motor and the like). 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.

[0049] When yarn breakage is detected, or when a yarn quality measurement device 27 described later detects a yarn defect and cuts the spun yarn 10, the unit controller 95 immediately controls to open an electromagnetic valve to open, and controls to supply compressed air to a lift-up air cylinder (not shown) connected to the cradle 31. As a result, the package 15 is lifted away from the winding drum 30. At the same time, the unit controller 95 controls to open an electromagnetic valve to supply compressed air to a brake piston (not shown). As a result, the brake piston is driven to brake the rotation of the package 15.

[0050] The above-mentioned air cylinder is also used for partially supporting the weight of the package 15. Therefore, it is possible that a contact pressure between the package 15 and the winding drum 30 can be prevented from becoming excessively large even though the weight of the package 15 increase due to the much spun yarn 10 wound around the package 15.

[0051] The winder unit 1a includes a bobbin setting 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.

[0052] A cleaning mechanism (not shown) is appropriately provided in the vicinity of each of the above-mentioned devices. The cleaning mechanism removes fiber waste and waste yarn adhering to the devices by blowing compressed air from a blast port provided at an appropriate position. For example, the tension application device 25, the yarn quality measurement device 27, the waxing device 36, and a tension sensor 37 described later are provided with the cleaning mechanism.

[0053] 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.

[0054] 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.

[0055] 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.

[0056] 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.

[0057] 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.

[0058] 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.

[0059] A lower yarn guide pipe 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.

[0060] 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 splicing 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.

[0061] 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.

[0062] 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.

[0063] 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.

[0064] The bobbin feed device 3 is, though not shown, provided with a bobbin individual feed device which is called a parts feeder, for enabling the yarn feed bobbins 12 to be aligned in a constant posture.

[0065] The yarn feed bobbin 12 which is conveyed in the parts feeder has a bunch winding so 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. The parts feeder is provided with an air blast for blowing away fiber waste and the like.

[0066] 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.

[0067] 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.

[0068] To be specific, the conveyance passage 6 includes a feed conveyance passage 6a, a return convey-

ance 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.

[0069] 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.

[0070] 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.

[0071] 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.

[0072] 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.

[0073] 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.

[0074] 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.

[0075] 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.

[0076] 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. 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.

[0077] 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.

[0078] 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.

[0079] 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.

[0080] 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.

[0081] Next, a process concerning the bobbin 13 discharged from the automatic winder 1 will be briefly described.

[0082] 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.

[0083] 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.

[0084] 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.

[0085] 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.

[0086] 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 clumper (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 sucked by a suction device (not shown) and collected into the cotton collection box 19. 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.

[0087] In the automatic winder system 100 having the above-described configuration, compressed air is used at each device supplied from the compressed air supply source. More specifically, the compressed air is used at the following devices.

[0088] In the yarn joining device 26 of automatic winder 1, the compressed air is used in order to twist and untwist spun yarn 10.

[0089] In the lower yarn blow-up part 24, the compressed air is used to blow up the lower yarn from the yarn feed bobbin 12 toward the yarn joining device 26.

[0090] In the tension application device 25, the yarn quality measurement device 27, the waxing device 36, and the tension sensor 37 of the automatic winder 1, the compressed air is used as the air blast for removing the yarn waste and the like. In the bobbin feed device 3, the compressed air is used as the air blast.

[0091] In the automatic winder 1, the compressed air is used in order to drive an air cylinder for lifting up the cradle 31 and to drive the brake piston for braking the rotation of the package 15. The compressed air is used in order to drive air cylinders of suction-type yarn end drawing device 8 and the remaining yarn processing device 49 of the bobbin preparation system 2.

[0092] In a cutter disposed next to the yarn quality measurement device 27 of automatic winder 1, a cutter of the part feeder of the bobbin feed device 3, and a cutter of the bunch unwinding device 7 or suction-type yarn end drawing device 8 of the bobbin preparation system 2, the compressed air is used for cutting operation of the cutters.

[0093] In the hitch-type yarn end drawing device 8 of the bobbin preparation system 2, the compressed air is used for blasting air from the compressed air injection nozzle.

[0094] In this embodiment, the yarn joining device 26 and the lower yarn blow-up part 24 of the automatic winder 1 correspond to the compressed air consuming devices of the present invention. The air blast devices disposed at each part of the bobbin feed device 3 of the automatic winder 1 correspond to the compressed air consuming devices. Moreover, the air cylinder for lifting up the cradle 31 of the automatic winder 1, the air cylinder for braking the rotation of the package 15, and the air cylinder of the suction-type yarn end drawing device 8 and the remaining yarn processing device 49 of the bob-

bin preparation system 2 correspond to the compressed air consuming devices. Further, the cutter disposed next to the yarn quality measurement device 27 of automatic winder 1, the cutter of the part feeder of the bobbin feed device 3, and the cutter of the bunch unwinding device 7 or suction-type yarn end drawing device 8 of the bobbin preparation system 2 correspond to the compressed air consuming devices. The hitch-type yarn end drawing device 8a corresponds to the compressed air consuming devices.

[0095] Hereinafter, the devices such as blast nuzzle and the cylinder and the like that consume the compressed air yarns may be collectively referred to as compressed air consuming devices 90, 90 ... FIG. 4 illustrates only a few compressed air consuming devices 90, but actually, there are many compressed air consuming devices 90 as described above. Each of the compressed air consuming devices 90 consume the compressed air at only necessary timing, and consume the compressed air at appropriate time intervals regularly.

[0096] Electromagnetic valves (not shown) are disposed between each of the compressed air consuming device 90, 90, ..., and air supply source 50. The unit controller 95 controls to open the electromagnetic valves to supply a compressed air to each of the compressed air consuming device 90, 90, ... when necessary.

[0097] The unit controller 95 includes a storage section 95a and a calculation section (output section) 95b.

[0098] 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.

[0099] When the unit controller 95 controls to open the electromagnetic valve, the unit controller 95 obtains compressed air consumption through calculation based on the opening time of the electromagnetic valve, and sends the compressed air consumption to the integrated control device 91.

[0100] Electromagnetic valves (not shown) are disposed between each of the compressed air consuming device 90, 90, ..., in the automatic bobbin feed device 18 and air supply source 50. The automatic bobbin feed device 18 includes the automatic feed device controller 99. The automatic feed device controller 99 controls to open the electromagnetic valves to supply a compressed air to each of the compressed air consuming device 90, 90, ... when necessary.

[0101] 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. When the automatic feed device controller 99 controls to open the electromagnetic valve, the automatic feed device controller 99 obtains compressed air consumption through

calculation based on the opening time of the electromagnetic valve, and sends the compressed air consumption to the integrated control device 91.

[0102] The integrated control device 91 receives data on the compressed air consumption 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.

[0103] The main control unit 94 includes an aggregate section 94a.

[0104] 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.

[0105] The storage section 95a of the unit controller 95 and the storage section 99a of the automatic feed device controller 99 each store compressed air consumption per for example one second with respect to each device in advance. This consumption can be defined through, for example, an experiment performed in advance, or can be obtained empirically. The compressed air consumption per unit time stored in the storage section 95a, 99a can be set by operating the input unit 93 of the integrated control device 91. The compressed air consumption per one second being stored, the accurate compressed air consumption is calculated without understanding detailed configuration for consuming the compressed air consumption such as magnitude of pressure of compressed air or cross sectional area of pipes by an operator.

[0106] The calculation section 95b of the unit controller 95 calculates compressed air consumption. To be specific, the calculation section 95b calculates the compressed air consumption by multiplying the compressed air consumption per unit time of each device stored in the storage section 95a by opening time of a valve. The unit controller 95 sends the obtained compressed air consumption to the integrated control device 91.

[0107] In the same manner, the calculation section 99b of the automatic feed device controller 99 calculates compressed air consumption. To be specific, the calculation section 99b calculates the compressed air consumption by multiplying the compressed air consumption per unit time of each device stored in the storage section 99a by the above-described opening time of a valve. The automatic feed device controller 99 sends the obtained compressed air consumption to the integrated control device 91.

[0108] The integrated control device 91 accumulates the compressed air consumption received from the unit controller 95 and the automatic feed device controller 99, while separating the compressed air consumption of the automatic winder 1 from the compressed air consumption of 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 compressed air is calculated for each winder unit 1a.

[0109] The compressed air consumption may be calculated by using not a value per one second but a value per one operation. That is, the storage section 95a of the unit controller 95 and the storage section 99a of the automatic feed device controller 99 each store compressed air consumption per for example one operation with respect to each device in advance. The calculation section 95b, 99b calculate the compressed air consumption by multiplying the compressed air consumption per operation number of each device by operation number.

[0110] The calculation section 95b, 99b can switch between a mode (a first calculation mode) for calculating the compressed air consumption by multiplication using the compressed air consumption per one second, and another mode (a second calculation mode) for calculating the compressed air consumption by multiplication using the compressed air consumption per one operation. The operator can switch the modes by appropriately operating the input unit 93 of the integrated control device 91.

[0111] As shown in FIG. 5, the main control unit 94 outputs a result of the computation to an air consumption display area 56 of the display 92. The display 92 can display both compressed air consumption of the entire automatic winder system 100 and compressed air consumption of each winder unit 1a, as will be detailed later.

[0112] An exemplary display on the display 92 will now be described in detail with reference to FIG. 5.

[0113] 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.

[0114] The lot information display field 51 displays a yarn count (thickness) and a yarn speed of the yarn received.

[0115] 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.

[0116] 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.

[0117] In the display screen, the numerical value display area 58 and the graph display area 62 are disposed.

[0118] 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.

[0119] 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.

[0120] The power consumption display area 55 displays the amount of power consumed so far.

[0121] The air consumption display area 56 displays the amount of compressed air consumed so far.

[0122] The waste yarn amount display area 57 displays the amount of waste yarn emitted so far. The waste yarn means a part of a spun yarn 10 that is to be wound by the automatic winder 1 but is not wound as a result of breakage of the spun yarn 10 with some cause. Examples of the some cause include voluntary cutting of the spun yarn 10 implemented by an operation of the automatic winder 1, occurrence of the spun yarn 10 cutting due to an excessive force applied to a yarn defect, and the like.

[0123] 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.

[0124] 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 compressed air consumption than the others to be noticed by the operator at an early stage, for example.

[0125] 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.

[0126] 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.

[0127] In the air consumption display area 56, the total amount display area 56a displays the total compressed air consumption of the entire automatic winder system 100. Disposed below the particulars display area 56a are particulars display areas 56b, 56c.

[0128] The particulars display area 56b in the upper

stage displays compressed air consumption of the automatic winder 1 (that is, of the plurality of winder units 1a as a whole). The particulars display area 56b in the middle stage displays compressed air consumption used of an air blast of a bobbin conveyor route. The particulars display area 56c in the lower stage displays compressed air consumption of the bobbin preparation system 2 and/or the bobbin feed device 3.

[0129] 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.

[0130] The compressed air consumption output device 100 of this embodiment is able to acquire compressed air consumption through calculation based on stored information, and display the compressed air consumption on the display 92. Accordingly, efficient information that is useful for improving energy saving.

[0131] The operator grasps the compressed air consumption based on the display information of the display 92, and the operator can examine whether the compressed air consumption which is used by the air blast and the like is appropriate or not for example, the operator can make a hypothesis that there may be room for reducing the amount of air blast if the device is kept clean. In this manner, the automatic winder system 100 may be adjusted for better operation while minimizing the compressed air consumption.

[0132] In this embodiment, an air flowmeter for actually measuring the compressed air consumption is unnecessary. Therefore, it is possible to prevent the structure from becoming complicated, and there is no fear that the air flowmeter will fail.

[0133] In this embodiment, the compressed air consumption output device 150 obtains compressed air consumption through calculation, and therefore merely a simple application is needed to execute simulation calculation. Several examples are shown and described below.

[0134] In the automatic winder 1 of this embodiment, the operator can appropriately operate the integrated control device 91 to change the blast time of the compressed air, for example, with respect to the air blast of the cleaning mechanism. The blast time of the compressed air corresponds to the opening time of the electromagnetic valve described above.

[0135] FIG. 6 shows a case where the blast time of the air blast in a certain cleaning mechanism is changed from 1.0 second to 1.3 second. 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 compressed air consuming device 150 can estimate compressed air consumption that would be caused if the setting is changed, and display a resulting value. This simulation display enables the operator to confirm the likelihood that compressed air consumption will vary, and determine whether to fix the change or to reconsider.

[0136] The simulation described above can be performed by, for example, a known calculation in which how many times the air blast is performed on the average per hour, for example, is recorded in the unit controller 95 or the automatic feed device controller 99, and this information and the blast amount per unit time described above are used. However, the above-mentioned recording may be performed in the integrated control device 91.

[0137] In some cases, it is effective to predict the compressed air consumption for setting other than the blast time of the compressed air. 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 compressed air consumption of the yarn joining device 26 will increase. The integrated control device 91 can simulate compressed air consumption that would be caused if the fault discrimination threshold for the yarn quality measurement device 27 is changed, and can display a resulting value.

[0138] In changing the setting such as a yarn count or a yarn speed, the integrated control device 91 is also able to execute simulation calculation to obtain how much compressed air consumption would be under conditions after the change, and display an obtained result on the display 92.

[0139] In this manner, this embodiment enables the operator to confirm the current compressed air consumption, and to easily consider how compressed air consumption would be influenced under various conditions. Accordingly, it is possible to operate the automatic winder system 100 with an aspect of compressed air consumption taken into account.

[0140] The compressed air consuming devices of the automatic winder 1 of this embodiment include a configuration which can replace another type compressed air consuming device. For example, the yarn joining device 26 includes a first yarn joining device (first compressed air consuming device) 261 for joining natural fiber spun yarns twisted by only natural fibers, and a second yarn joining device (second compressed air consuming device) 262 for joining expanded yarns obtained by coating the periphery of synthetic fiber yarns having expansion and contraction performance with natural fibers. In order to deal with this, the storage section 95a of the unit controller 95 stores both the first compressed air consumption which is the compressed air consumption per multiplication unit when the first yarn splicing device 261 operates and the second compressed air consumption which is the compressed air consumption per multiplication unit when the second yarn splicing device 262 operates. The first compressed air consumption and the second compressed air consumption are switched in conjunction with the operator replacing the first yarn joining device 261 and the second yarn joining device 262.

More specifically, an operator who removes the first yarn joining device 261 and attaches the second yarn joining device 262 operates the input unit 93 of the integrated control device 91 to input that the second yarn joining device 262 has been attached. Accordingly, the compressed air consumption output device 150 specifies that the second yarn joining device 262 has been attached based on the setting of the integrated control device 91. Thereafter, the compressed air consumption output device 150 reads the second compressed air consumption from the storage section 95a, and uses the second compressed air consumption for the subsequent compressed air consumption calculation. Alternatively, the compressed air consumption output device 150 may specify that the second yarn joining device 262 is attached by detecting which of the first yarn joining device 261 and the second yarn joining device 262 is attached by a sensor. Also in this case, the compressed air consumption output device 150 automatically switches the compressed air consumption used in the subsequent compressed air consumption calculation to the second compressed air consumption amount. In this manner, by interlocking a plurality of types of compressed air consuming devices with a plurality of types of compressed air consumption, it is possible for an operator to calculate an accurate compressed air consumption without understanding detailed numerals such as magnitude of pressure of compressed air or cross sectional area of pipes. The storage section 95a may store three or more types of compressed air consuming device and corresponding compressed air consumption.

[0141] As thus far described, the compressed air consumption output device 150 of this embodiment outputs compressed air consumption of automatic winder 1. The automatic winder 1 includes a plurality of compressed air consuming devices and a plurality of winding units 1a that wind spun yarns 10. The compressed air consumption output device 150 includes a storage section 95a, an output section 95b, and a display unit 92. The storage section 95a stores the compressed air consumption per multiplication unit time of each of the compressed air consuming devices. The calculation section 95b calculates and outputs the compressed air consumption by multiplication using the compressed air consumption per multiplication unit for each of the compressed air consuming devices. The display 92 displays compressed air consumption outputted by the calculation section 95b.

[0142] Accordingly, an operator can easily examine the operation of the automatic winder 1 in consideration of energy saving and the like with reference to the compressed air consumption of the automatic winder 1 displayed on the display 92. Further, since it is unnecessary to provide an air flowmeter for measuring a flow rate of compressed air in a pipe or the like, it is possible to reduce the cost and prevent an increase in maintenance labor. Moreover, since the automatic winder 1 have a plurality of the compressed air consuming devices, application of the present invention to the automatic winder 1 is espe-

cially effective because the compressed air consumption can be calculated with a simple calculation without using individual formula of each device.

[0143] In the compressed air consumption output device 150 of this embodiment, the storage section 95a stores the compressed air consumption per multiplication unit time of each of the compressed air consuming devices. In the first calculation mode, the calculation section 95b obtains the compressed air consumption by multiplication using the compressed air consumption per multiplication unit time of the compressed air consuming devices.

[0144] In the first calculation mode, the compressed air consumption can be easily obtained based on the time during which the compressed air consuming device consumes the compressed air.

[0145] In the compressed air consumption output device 150 of this embodiment, the storage section 95a stores the compressed air consumption per multiplication unit operation number of each of the compressed air consuming devices. In the second calculation mode, the calculation section 95b obtains the compressed air consumption by multiplication using the compressed air consumption per multiplication unit operation number of the compressed air consuming devices.

[0146] In this mode, the compressed air consumption can be easily obtained based on the number of the operation of the compressed air consuming device.

[0147] In the compressed air consumption output device 150 of this embodiment, the calculation section 95b can switch between a first calculation mode and a second calculation mode.

[0148] With this configuration, the compressed air consumption can be obtained in an appropriate manner depending on the situation.

[0149] In the compressed air consumption output device 150 of this embodiment, displaying of a compressed air consumption on the display 92 is updated while the automatic winder 1 is operating.

[0150] Accordingly, promptness of the displaying can be obtained easily. Thus, even when compressed air consumption has an unusual status during an operation of the automatic winder 1, it is easy to deal with the status at an early stage.

[0151] The compressed air consumption output device 150 of this embodiment can change setting on consuming the compressed air of the compressed air consuming device. In changing the setting, a simulation calculation result indicating a compressed air consumption that would be caused by the change is displayed on the display 92.

[0152] Accordingly, when the operator makes setting, the operator can refer to how the compressed air consumption will be influenced in advance.

[0153] In the compressed air consumption output device 150 of this embodiment, the display 92 simultaneously displays not only the compressed air consumption but also at least either of power consumption in the au-

tomatic winder or waste yarn emission amount in the automatic winder.

[0154] This can enhance completeness of information, allowing an overall status of the automatic winder 1 to be grasped easily.

[0155] In the compressed air consumption 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 compressed air consuming device.

[0156] Accordingly, the compressed air consumption can be easily grasped for the automatic winder 1 including a plurality of the compressed air consuming devices.

[0157] In the compressed air consumption output device 150 of this embodiment, the display 92 is capable of displaying total compressed air consumption of the plurality of winder units 1a on a particulars display area 56b.

[0158] This makes it possible to compare the total compressed air consumption of the plurality of winding units with compressed air consumption of another part, for examination.

[0159] In the compressed air consumption output device 150 of this embodiment, the automatic winder 1 can replace the first yarn joining device 261 and the second yarn joining device 262. The storage section 95b stores first compressed air consumption per multiplication unit of the first yarn joining device 261 and second compressed air consumption per multiplication unit of the second yarn joining device 262. The calculation section 95b determines which of the first yarn joining device 261 and the second yarn joining device 262 is attached to the automatic winder 1, and calculates the compressed air consumption according to the determination result.

[0160] Accordingly, the calculation section 95b can calculate the compressed air consumption even when either the first yarn joining device 261 or the second yarn joining device 262 is attached.

[0161] The automatic winder 1 of this embodiment includes the compressed air consumption output device 150.

[0162] Accordingly, efficient use of the compressed air can be achieved easily.

[0163] Although a preferred embodiment of the present invention has been described above, the configuration above can be modified, for example, as follows.

[0164] 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.

[0165] 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 compressed air consumption output device is consti-

tuted by a combination of the integrated control device 91 with the unit controllers 95. The compressed air consumption output device may be configured to display compressed air consumption of whole of a plurality of winding unit 1a on the display 92, compressed air consumption which is used in air blast of the bobbin conveyor route, and total consumption, for example.

[0166] Instead of displaying volume of used compressed air on the display 92, power consumption for generating the compressed air may be displayed on the display 92.

[0167] The integrated control device 91 (compressed air consumption output device 150) can either output obtained information on compressed air consumption 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.

[0168] In the embodiment described above, storage section 95a of unit controller 95 stores compressed air consumption per multiplication unit, and calculation section 95b calculates the compressed air consumption. In the same manner, storage section 99a of automatic feed device controller 99 stores compressed air consumption per multiplication unit, and calculation section 99b calculates the compressed air consumption. These storing and calculating, however, may be implemented by a storage section and 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 compressed air consumption output device.

[0169] In the embodiment described above, a result of calculating compressed air consumption 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 compressed air consumption. In such a configuration, the compressed air consumption 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 setting of the blast time of the air blast for example, may be implemented by the winder unit 1a and the automatic bobbin feed device 18.

[0170] Either of the first calculation mode or the second calculation mode may be omitted. In other words, compressed air consumption output device 150 may be modified such that the compressed air consumption output device 150 can calculate compressed air consumption by using either the method of multiplying time or the other method of multiplying the number of times of operation.

[0171] When calculating compressed air consumption in view of time, the storage section 95a, 99a may store compressed air consumption per ten seconds for example, instead of one second. In such case, the multiplication unit time is not one second but ten seconds.

[0172] When calculating compressed air consumption in view of the number of times of operation, the storage

section 95a, 99a may store compressed air consumption per one hundred times for example, instead of one time. In such case, the multiplication unit operation number is not one time but one hundred times.

[0173] The compressed air may consume in various purposes and methods other than the examples of this embodiment.

[0174] The automatic winder 1 or the automatic winder system 100 may include the compressed air supply source.

Claims

1. A compressed air consumption output device that outputs compressed air consumption of an automatic winder including a plurality of compressed air consuming devices and a plurality of winding units for winding yarns comprising:

a storage section that stores compressed air consumption per multiplication unit while each of the compressed air consuming devices uses compressed air;

an output section that calculates and outputs the compressed air consumption by multiplication using the compressed air consumption per multiplication unit for each of the compressed air consuming devices; and

a display unit that displays the compressed air consumption outputted by the output section.

2. The compressed air consumption output device according to claim 1, wherein:

the storage section stores compressed air consumption per multiplication unit time of each of the compressed air consuming devices; and the output section obtains the compressed air consumption by multiplication using the compressed air consumption per multiplication unit time of each of the compressed air consuming devices.

3. The compressed air consumption output device according to claim 1, wherein:

the storage section stores compressed air consumption per multiplication unit operation number of each of the compressed air consuming devices; and

the output section obtains the compressed air consumption by multiplication using the compressed air consumption per multiplication unit operation number of each of the compressed air consuming devices.

4. The compressed air consumption output device ac-

according to claim 1, wherein:
the output section can switch between

a first calculation mode for calculating the compressed air consumption by multiplication using compressed air consumption per unit time of each of the compressed air consuming devices and
a second calculation mode for calculating the compressed air consumption by multiplication using compressed air consumption per multiplication unit operation number of each of the compressed air consuming devices.

5. The compressed air consumption output device according to any one of claim 1 to 4, wherein displaying of the compressed air consumption on the display unit is updated while the automatic winder is operating.

6. The compressed air consumption output device according to any one of claim 1 to 5, wherein:

a setting on consuming compressed air of the compressed air consuming device is changeable; and
in changing the setting, a simulation calculation result indicating compressed air consumption that would be caused by the change is displayed on the display unit.

7. The compressed air consumption output device according to any one of claim 1 to 6, wherein the display unit simultaneously displays not only the compressed air consumption but also at least either of power consumption in the automatic winder or a waste yarn emission amount in the automatic winder.

8. The compressed air consumption output device according to any one of claim 1 to 7, wherein the display unit is capable of displaying total compressed air consumption of the plurality of winding units.

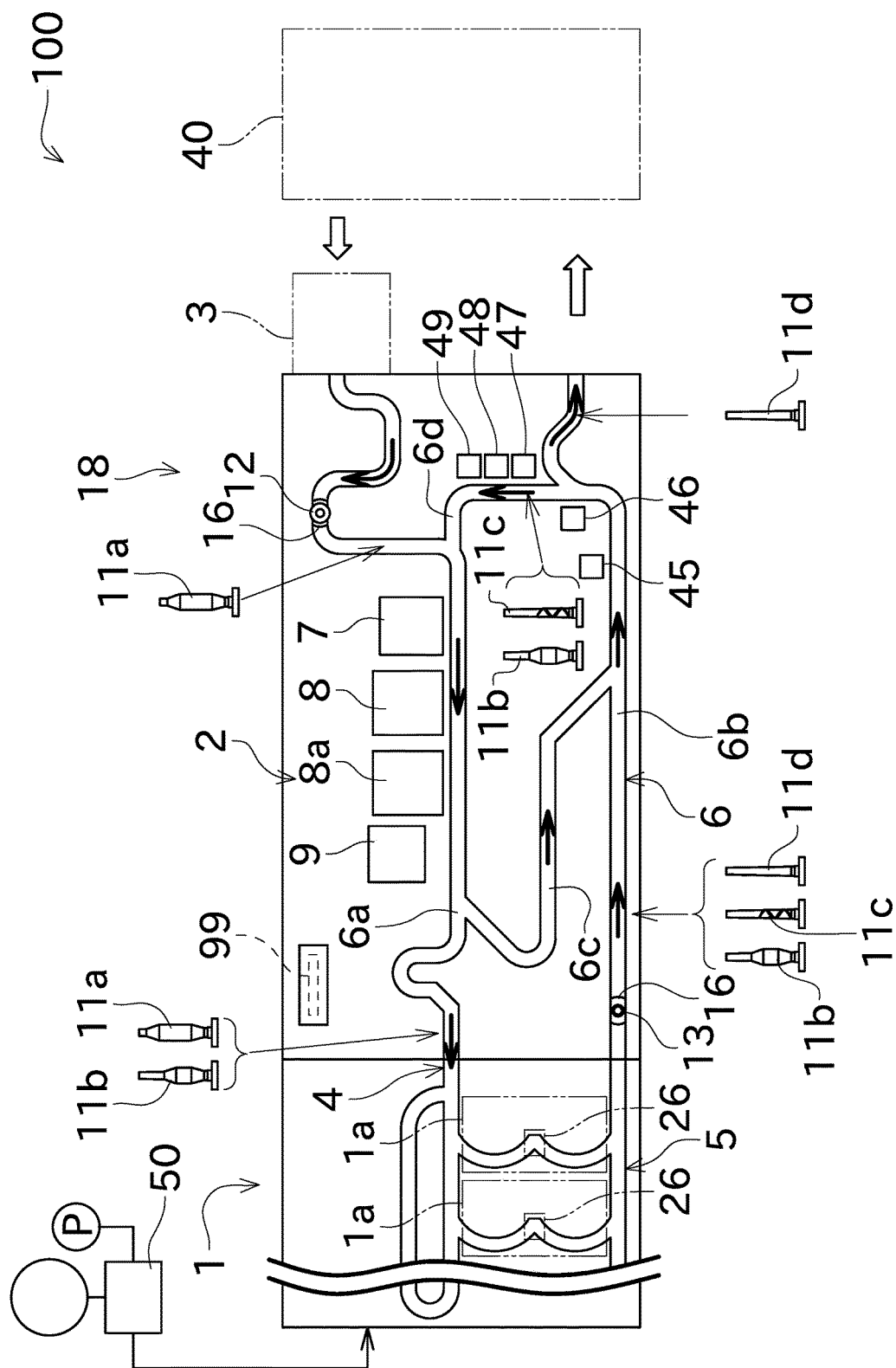
9. The compressed air consumption output device according to any one of claim 1 to 8, wherein:

the automatic winder can replace a first compressed air consuming device and a second compressed air consuming device;
the storage section stores compressed air consumption per multiplication unit of the first compressed air consuming device and compressed air consumption per multiplication unit of the second compressed air consuming device; and
the output section determines which of the first compressed air consuming device and the second compressed air consuming device is at-

tached to the automatic winder, and calculates the compressed air consumption according to the determination result.

10. The automatic winder comprising the compressed air consumption output device according to any one of claim 1 to 9.

Fig. 1



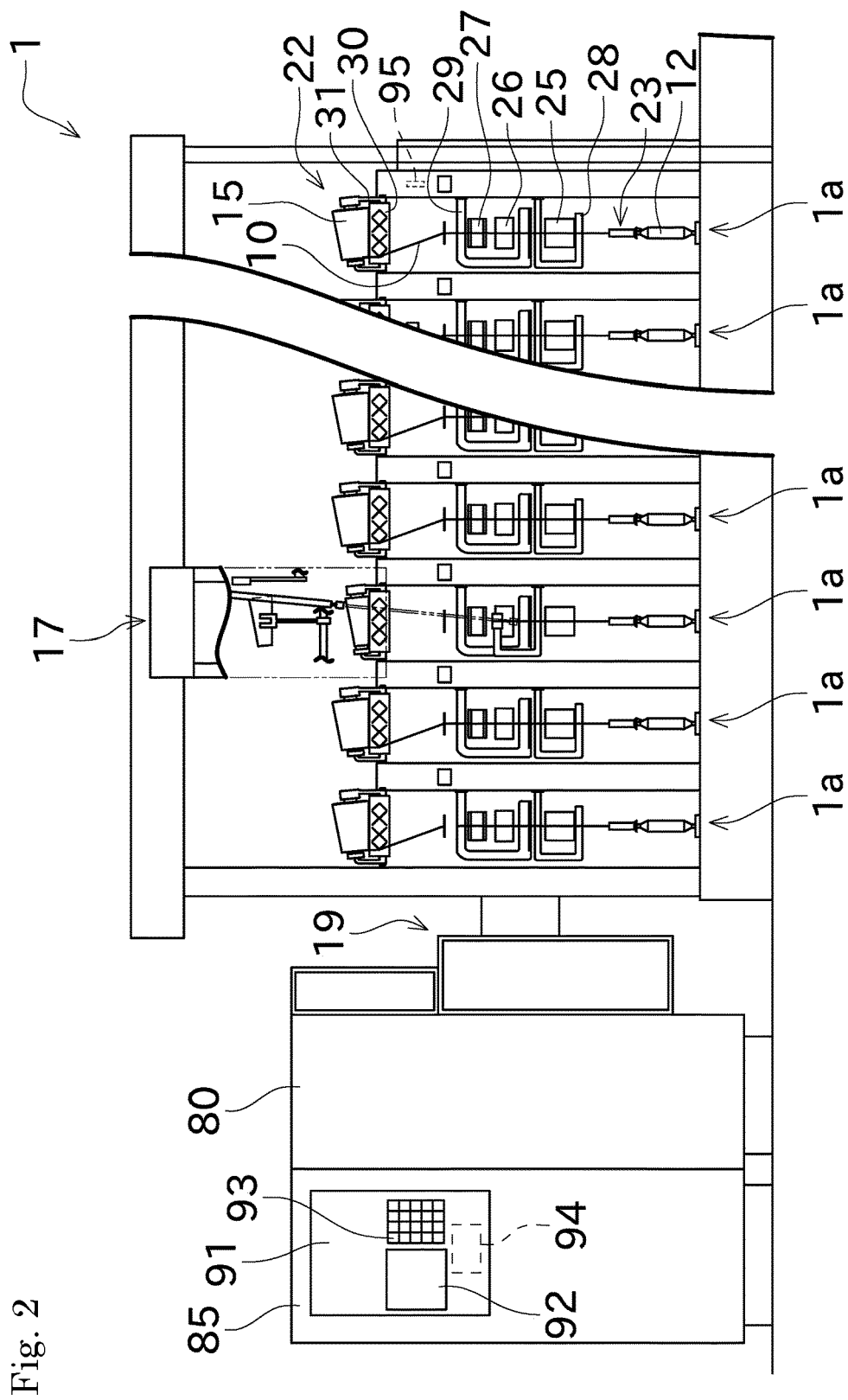


Fig. 2

Fig. 3

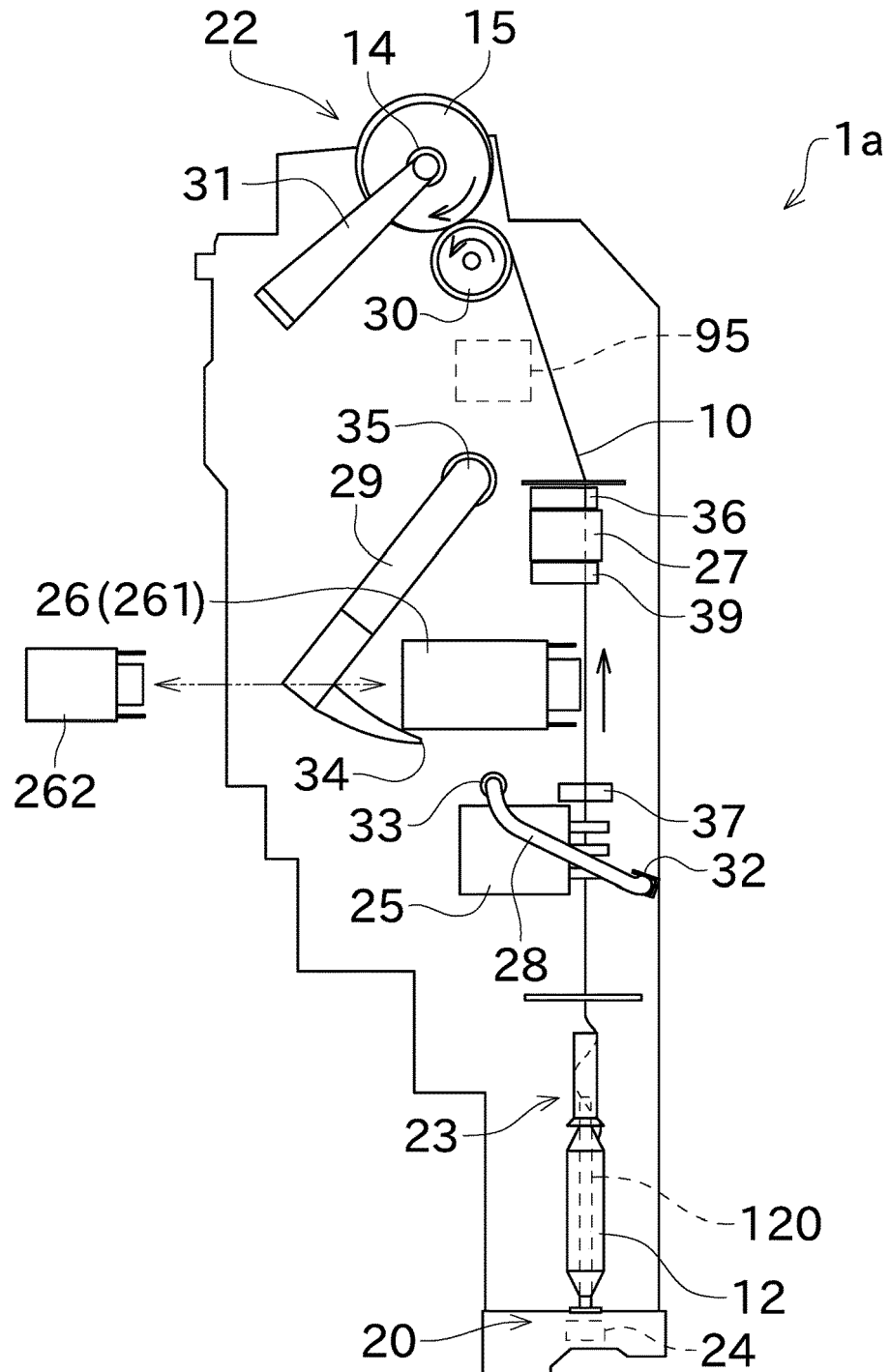


Fig. 4

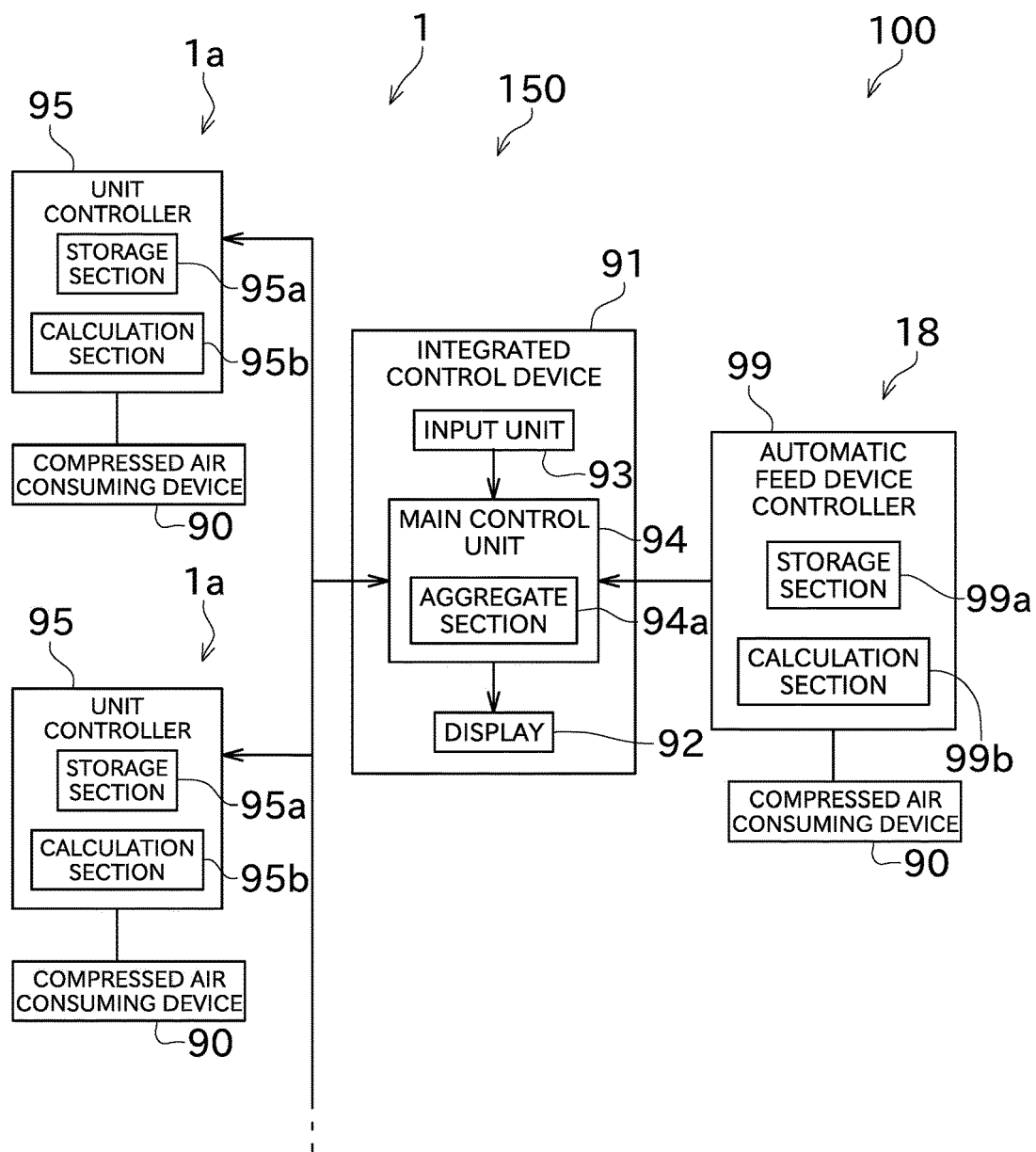


Fig. 5

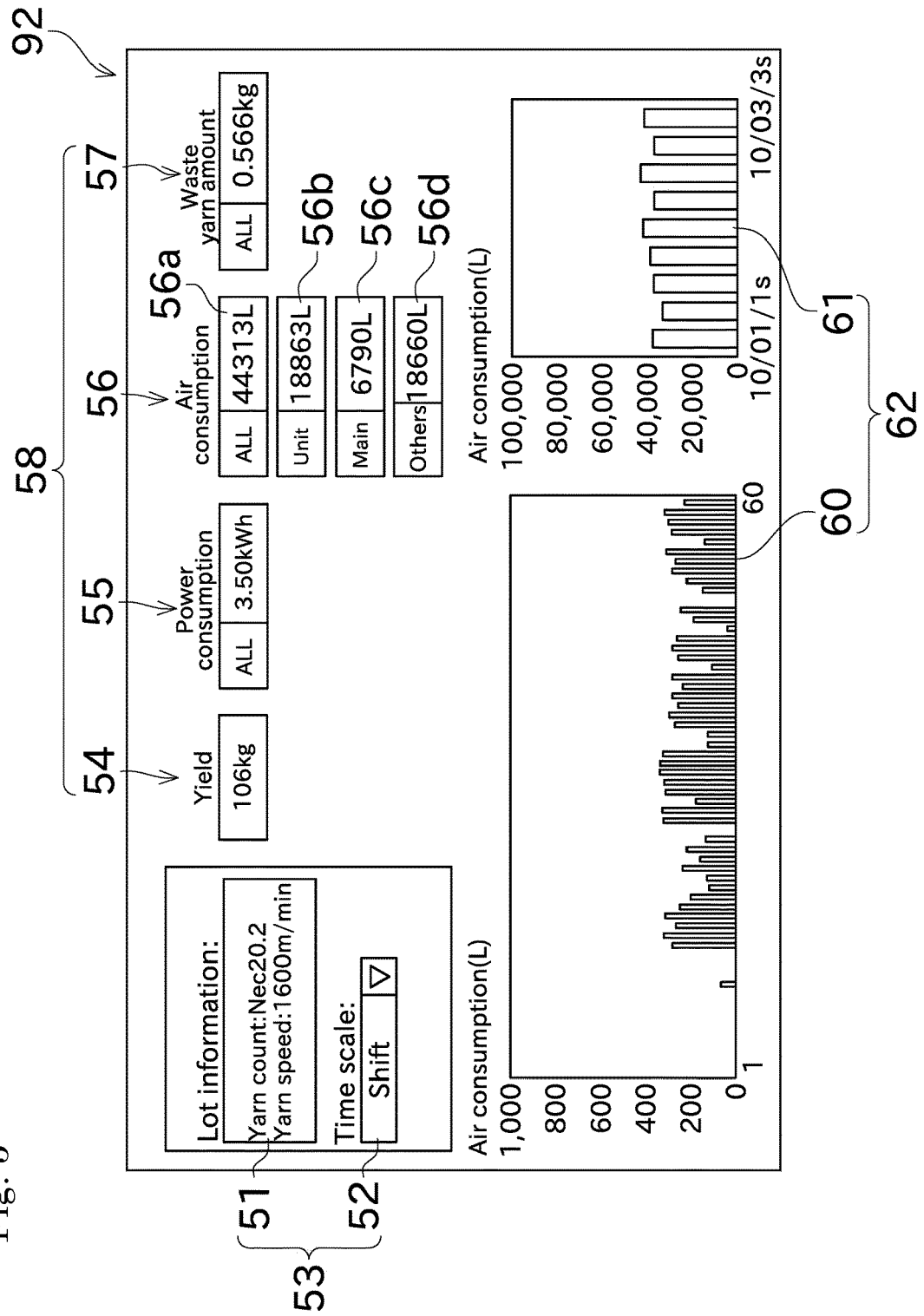
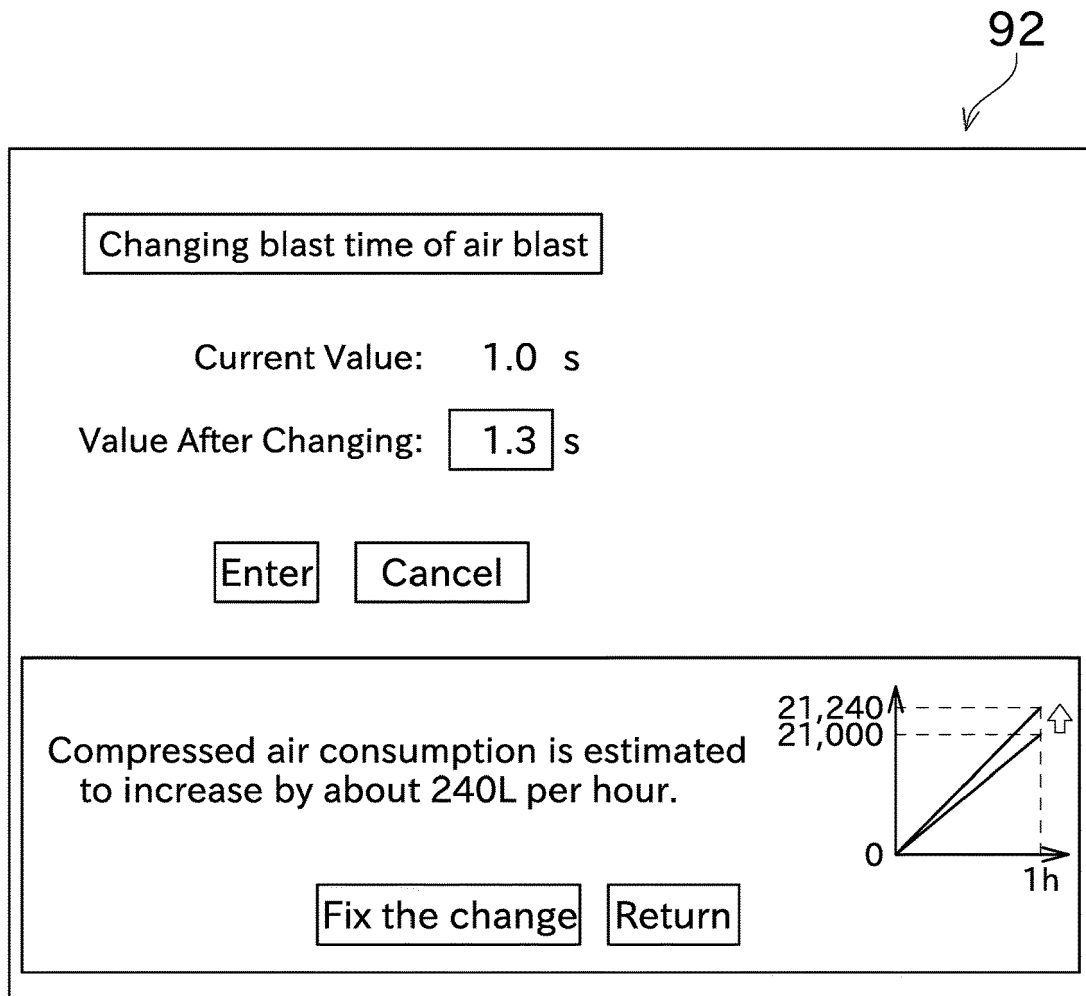


Fig. 6





EUROPEAN SEARCH REPORT

Application Number
EP 20 16 0621

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2002 138346 A (TOYOTA IND CORP) 14 May 2002 (2002-05-14)	1-9	INV.
A	* paragraph [0005] - paragraph [0016]; figures 1,2 *	10	B65H54/22 B65H69/06
	* paragraph [0022] *		

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			B65H D01H D03D
Place of search		Date of completion of the search	Examiner
Munich		3 July 2020	Todarello, Giovanni
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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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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