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(72) Inventors:
• **Makino, Yoichi**
Kariya-shi, Aichi 448-8671 (JP)
• **Okuda, Taijiro**
Kariya-shi, Aichi 448-8671 (JP)

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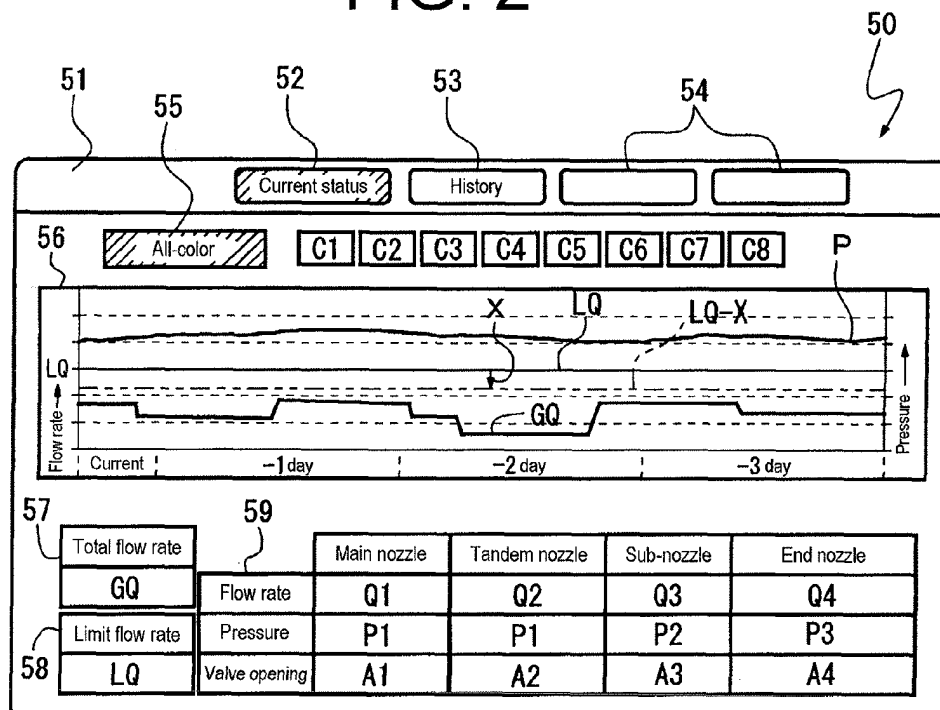
(74) Representative: **TBK**
Bavariaring 4-6
80336 München (DE)

(71) Applicant: **Kabushiki Kaisha Toyota Jidoshokki**
Kariya-shi, Aichi 448-8671 (JP)

(54) **Apparatus for showing compressed air flow rate in an air jet loom**

(57) An apparatus for showing compressed air flow rate in an air jet loom includes a main nozzle and sub-nozzles causing a weft yarn to move by means of compressed air, a flow rate measuring device that serves to measure flow rate of compressed air consumed in the

air jet loom, and a controller equipped with a display. The controller causes the display to show a time series graph of the measured flow rate of compressed air together with a time series graph of a previously set upper limit flow rate of compressed air for the air jet loom.

FIG. 2

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an apparatus for showing flow rate of compressed air for weft insertion in an air jet loom.

[0002] Generally, in a weaving factory having plural air jet looms, one or more air compressors are installed depending on the number of air jet looms for supplying compressed air to the respective air jet looms. The flow rate of compressed air required to be supplied by the air compressor depends on the sum of the compressed air consumption of all air jet looms in the factory, and also is directly linked to the electric power consumption of the air compressor. Conventionally, in order to minimize the wasteful electric power consumption, a limit of the flow rate of compressed air to be used in each air jet loom is empirically determined depending on the electric power consumption of the air compressor, and the air compressor is operated depending on the sum of the limits. When the compressed air consumption of the air jet loom exceeds the limit, an alarm signal is issued.

[0003] Although not concerned with electric power consumption, Japanese Unexamined Patent Application Publication No. 2-175956 discloses a device concerned with compressed air consumption in an air jet loom. To detect a failure of components associated with weft insertion while the air jet loom is operating, there is provided an air consumption gauge in a compressed air supply line between a compressed air source and a weft insertion nozzle. There are set an upper threshold and a lower threshold for a normal air consumption. When the measured air consumption exceeds the upper threshold or falls below the lower threshold, a loom stop signal indicative of a failure of any weft insertion component is transmitted, and a signal distinguishing between the upper and lower thresholds is also transmitted. In the device disclosed by the above publication, however, no measurement is made of the compressed air consumption for breeze that is supplied constantly during a stop of the loom as well as during the operation and also of the compressed air consumption during inching operation of the loom.

[0004] In the conventional art such as the publication No. 2-175956, the upper threshold or limit for air consumption is empirically determined. The use of such empirically determined parameter for reducing the electric power consumption of an air compressor does not necessarily minimize the compressed air consumption of the air jet loom efficiently. For example, there may occur such simple mistakes that the speed of the air jet loom is lowered but the compressed air pressure at the main nozzle and sub-nozzle is maintained or the compressed air pressure at the main nozzle and sub-nozzle is excessively increased while the loom is operating.

[0005] When such operation is continued, it cannot be found that the upper threshold or limit for air consumption can be lowered, thereby inviting wasteful air compressor

operation. On the other hand, some air jet looms in the factory may be operating at a lowered speed so that the air consumption is reduced, but it cannot be found whether such reduction of air consumption is temporary or continuing. In this case, the loom is operated at the upper threshold or limit for air consumption that has been set before the loom speed is lowered, which leads to wasteful operation of the air compressor.

[0006] The present invention is directed to lowering the upper limit of flow rate for air consumed in an air jet loom as much as possible and hence minimizing wasteful consumption of air.

SUMMARY OF THE INVENTION

[0007] In accordance with an aspect of the present invention, an apparatus for showing compressed air flow rate in an air jet loom includes a main nozzle and sub-nozzles causing a weft yarn to move by means of compressed air, a flow rate measuring device that serves to measure flow rate of compressed air consumed in the air jet loom, and a controller equipped with a display. The controller causes the display to show a time series graph of the measured flow rate of compressed air together with a time series graph of a previously set upper limit flow rate of compressed air for the air jet loom.

[0008] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a configuration block diagram of a weft insertion device and an apparatus for showing compressed air flow rate of an air jet loom according to an embodiment of the present invention;

Fig. 2 shows a screen of a display of the air jet loom, on which upper limit of flow rate and measured flow rate of compressed air are shown;

Fig. 3 is similar to Fig. 2, but showing that the change of the measured flow rate is different from that of Fig. 2; and

Fig. 4 shows another screen of the display, on which changes of items associated with the adjustment of main nozzle and sub-nozzle are shown.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0010] The following will describe one embodiment of an apparatus for showing compressed air flow rate in an air jet loom according to the present invention with reference to Figs. 1 to 4. It is noted that the terms "upstream"

and "downstream" appearing in the following description are used to denote directions or relative positions with respect to the direction in which a weft yarn is inserted into a warp shed and also in which compressed air supplied from an external source flows.

[0011] Referring to Fig. 1, the air jet loom designated by 1 includes a weft insertion device 2, plural sub-nozzles 3 and end nozzles 4 disposed downstream of the weft insertion device 2. In the drawing, compressed air supply line to the weft insertion device 2, the sub-nozzles 3 and the end nozzles 4 is also shown in the form of a block diagram. The weft insertion device 2 has a main nozzle 5 and a tandem nozzle 6 disposed upstream of the main nozzle 5. The main nozzle 5, the sub-nozzles 3 and the end nozzles 4 are disposed on a slay (not shown) and swing back and forth with the slay.

[0012] The tandem nozzle 6 is fixedly mounted to a frame (not shown) of the air jet loom 1 or to a bracket (not shown either) mounted on the floor. There is provided upstream of the tandem nozzle 6 a weft measuring and storing device 8 equipped with a movable pin (not shown) that is operable to engage with or disengage from a weft yarn Y. The weft measuring and storing device 8 serves to measure a predetermined length of weft yarn Y, i.e. a length that corresponds to the weaving width of the loom, drawn from a yarn supply package 7 and also to store temporarily the weft yarn Y. Although only one set of the weft insertion device 2 and its associated yarn supply package 7 and weft measuring and storing device 8 is shown in Fig. 1, the air jet loom 1 in the present embodiment is intended to include eight sets of the weft insertion devices 2 and their associated yarn supply packages 7 and weft measuring and storing devices 8, serving as a multicolor weft insertion device. It is noted that the multicolor weft insertion device may use not only weft yarns of different colors, but also weft yarns of the same color. The sub-nozzles 3 and the end nozzles 4 are used commonly for such eight sets of the weft insertion devices 2.

[0013] The main nozzle 5 is connected through a pipe 10 to a main valve 9 that allows or stops the supply of compressed air to the main nozzle 5. The tandem nozzle 6 is connected through a pipe 12 to a tandem valve 11 that allows or stops the supply of compressed air to the tandem nozzle 6. The main and tandem valves 9, 11 are both connected to a common main air tank 15 through pipes 13, 14, respectively. The main air tank 15 is connected through a main pressure gauge 16, a main regulator 17, an initial pressure gauge 18 and a filter 19 to a common air compressor (not shown) installed in a weaving factory. The initial pressure gauge 18 measures initial pressure of compressed air to be supplied from the factory air compressor to the air jet loom 1. The compressed air supplied from the air compressor is regulated to a predetermined pressure by the main regulator 17 and stored in the main air tank 15. The main pressure gauge 16 measures the pressure of compressed air to be supplied to the main air tank 15.

[0014] The main nozzle 5 is also connected to a breeze circuit 20 that is connected to the pipe 10 at a position downstream of the main valve 9 and bypasses the main valve 9. The breeze circuit 20 has a throttle valve 21 and a breeze regulator 22 and is connected directly to a pipe 23 that connects between the main regulator 17 and the initial pressure gauge 18 both provided upstream of the main air tank 15. The compressed air of initial pressure supplied from the air compressor is regulated by the breeze regulator 22 and the throttle valve 21 of the breeze circuit 20 so that a slight amount of low pressure compressed air is supplied constantly from the breeze circuit 20 through the pipe 10 to the main nozzle 5 and injected from the main nozzle 5. The compressed air thus injected from the main nozzle 5 serves to hold the weft yarn Y remaining in the main nozzle 5 after the completion of weft insertion in an appropriate position.

[0015] The sub-nozzles 3 are divided into three separate groups. The three groups of sub-nozzles 3 are connected through pipes 25 to respective sub-valves 24 which are fixedly mounted to a frame (not shown) of the air jet loom 1. The sub-nozzles 3 need not necessarily be separated into three groups. For example, four or more groups of sub-nozzles 3 and their associated sub-valves 24 may be provided depending on the weaving width of the loom. The sub-valves 24 are connected through pipes 26 to a common sub-air tank 27.

[0016] The sub-air tank 27 is connected to a sub-regulator 30 through a pipe 28 that is equipped with a sub-pressure gauge 29. The sub-regulator 30 is connected through a pipe 31 to the pipe 23 that connects between the main regulator 17 and the initial pressure gauge 18. The pressure of the compressed air supplied from the air compressor is adjusted to a predetermined pressure by the sub-regulator 30 and stored in the sub-air tank 27. The pressure of the compressed air supplied to the sub-air tank 27 is always measured by the sub-pressure gauge 29.

[0017] The end nozzles 4 are provided by plural sub-nozzles disposed adjacent to the selvage of woven fabric on the side of the reed (not shown) opposite from the main nozzle 5. The end nozzles 4 are connected through pipes 32 to a sub-valve 33 that is in turn connected through a pipe 34 to a sub-air tank 35. The sub-air tank 35 is connected to a sub-regulator 38 through a pipe 36 that is equipped with a sub-pressure gauge 37. The sub-regulator 38 is connected through a pipe 39 to the pipe 31 that is connected to the pipe 23.

[0018] The pressure of the compressed air supplied from the air compressor is regulated to a predetermined pressure by the sub-regulator 38 and stored in the sub-air tank 35. The sub-regulator 38 regulates the pressure of the compressed air to be supplied to the sub-air tank 35 to a pressure that is below the pressure of compressed air regulated by the sub-regulator 30. The sub-pressure gauge 37 measures the pressure of compressed air to be supplied to the sub-air tank 35. The end nozzles 4 inject air whose pressure has been regulated below the

injection pressure at the sub-nozzles 3, thereby controlling the flight speed of the weft yarn Y just before the completion of weft insertion and also reducing the consumption of compressed air.

[0019] The main valve 9, the tandem valve 11, the sub-valves 24, the sub-valve 33, the initial pressure gauge 18, the main pressure gauge 16, the sub-pressure gauge 29 and the sub-pressure gauge 37 are electrically connected to a controller 40 of the air jet loom 1 through electric wires 41, 42, 43, 44, 45, 46, 47, 48 and 49. The controller 40 is equipped with a display 50 having a screen 51 (see Fig. 2) where data and information of various items are indicated. Data for some items may be newly input and rewritten directly on the screen 51.

[0020] The initial pressure gauge 18 measures the initial pressure of compressed air supplied from the air compressor and transmits its data to the controller 40. The main pressure gauge 16 measures the pressure of compressed air regulated by the main regulator 17, the sub-pressure gauge 29 measures the pressure of compressed air regulated by the sub-regulator 30, and the sub-pressure gauge 37 measures the pressure of compressed air regulated by the sub-regulator 38. Such pressure data is respectively transmitted to the controller 40. The controller 40 previously stores data regarding the time when the pin of the weft measuring and storing device 8, the main valve 9, the tandem valve 11 and the sub-valves 24, 33 should start to operate and also data of the duration of such operation. The controller 40 also stores data regarding the openings of the respective valves 9, 11, 24, 33. The controller 40 transmits signals to the pin, the main valve 9 and the tandem valve 11 to start insertion of weft yarn Y, and subsequently transmits signals to the sub-valves 24, 33 during the insertion of weft yarn Y, so that insertion of weft yarn Y is completed.

[0021] Referring to Fig. 2, the screen 51 of the display 50 has a current status button 52, a history button 53 and other buttons 54. Fig. 2 shows the state of the screen 51 appearing when the current status button 52 is pressed to show the current status of the weft insertion device 2. The current status button 52, the history button 53 and the buttons 54 are always shown on the screen 51 even when the state of the screen 51 is changed.

[0022] The screen 51 in the current status mode shows, at one time, an all-color button 55 for indicating the total status of the eight sets of the weft insertion devices 2, color buttons C1 to C8 for indicating the status of the respective weft insertion devices 2, a graph display section 56, a total flow rate display section 57, an upper limit flow rate display section 58, and individual data display section 59 indicating data of flow rate, pressure and valve opening for the respective main nozzle 5, the tandem nozzle 6, the sub-nozzle 3 and the end nozzle 4. These display sections are shown based on a program stored in the controller 40.

[0023] The graph display section 56 shows time series line graphs of the total flow rate GQ and the initial pressure P for the current day and the last three days. The

total flow rate GQ, which is labeled on the vertical axis of the graph, is indicative of the compressed air consumption of the air jet loom 1 as the measured flow rate of compressed air, and the initial pressure P, which is also labeled on the vertical axis of the graph, is indicative of the initial pressure of compressed air supplied from the factory air compressor to the air jet loom 1. The graph display section 56 also shows a time series line graph of the upper limit flow rate LQ for the air jet loom 1 which is higher than the total flow rate GQ and previously set in the controller 40.

[0024] The total flow rate GQ includes the amount of compressed air consumed for the insertion of weft yarn Y during weaving and inching operation of the air jet loom 1, as well as, for example, the amount of compressed air consumed for the breeze injected from the main nozzle 5 during a stop of the weaving operation and also the amount of compressed air acting on the weft yarn Y. The compressed air acting on the weft yarn Y is the compressed air consumed, for example, by an air clamp for clamping a yarn end and an air tucker for forming a selvage. When the total flow rate GQ exceeds the upper limit flow rate LQ, the controller 40 transmits a signal which causes an alarm indication on the display 50 and an alarm lamp provided in the air jet loom 1 to be illuminated.

[0025] The total flow rate display section 57 shows the total flow rate GQ in numerical value which is indicative of the current compressed air consumption of the air jet loom 1, and the upper limit flow rate display section 58 shows the previously-set upper limit flow rate LQ for the air jet loom 1 in numerical value. The individual data display section 59 shows the current data of pressure, valve opening and flow rate associated with the main nozzle 5, the tandem nozzle 6, the sub-nozzle 3 and the end nozzle 4. As the data of pressure, there are shown on the individual data display section 59 the pressure P1 indicative of air pressure measured by the main pressure gauge 16, the pressure P2 indicative of air pressure measured by the sub-pressure gauge 29, and the pressure P3 indicative of air pressure measured by the sub-pressure gauge 37.

[0026] As the data of valve opening, there are shown the opening A1 indicative of the current opening of the main valve 9, the opening A2 indicative of the current opening of the tandem valve 11, the opening A3 indicative of the current opening of the sub-valve 24, and the opening A4 indicative of the current opening of the sub-valve 33. The part of the upper limit flow rate display section 58 where the upper limit flow rate LQ is shown and the part of the individual data display section 59 where the valve openings A1 to A4 are shown also function as switches or data change buttons. Pressing the data change buttons, the data of upper limit flow rate LQ and the data of valve openings A1 to A4 can be rewritten and changed on the screen 51 and the new data is registered in the controller 40.

[0027] As the data of flow rate, there are shown the

flow rate Q1 indicative of the total flow rate of the main nozzles 5 of the eight sets of the weft insertion devices 2, the flow rate Q2 indicative of the total flow rate of the tandem nozzles 6 of the eight sets of the weft insertion devices 2, the flow rate Q3 indicative of the flow rate of the sub-nozzle 3, and the flow rate Q4 indicative of the flow rate of the end nozzle 4. In the present embodiment, the data of flow rate shown in the total flow rate display section 57 and the individual data display section 59 is calculated from a formula that is based on the data of pressure and the data of valve opening. In the present embodiment, the controller 40, the pressure gauges 16, 29, 37 and the valves 9, 11, 24, 33 with various openings cooperate to serve as the flow rate measuring device of the present invention. The data of flow rates Q1 to Q4 is calculated and indicated by the controller 40, based on the data of pressures P1 to P3 and the data of valve openings A1 to A4. The total flow rate GQ is the sum of the flow rates Q1 to Q4 thus calculated and the other flow rates such as breeze calculated by the controller 40.

[0028] The following will describe the operation of the apparatus of the present embodiment. When the current status button 52 on the display 50 is pressed by a loom operator with the all-color button 55 set active, the graph display section 56, the total flow rate display section 57, the upper limit flow rate display section 58 and the individual data display section 59 are shown on the screen 51 of the display 50. When one of the color buttons C1 to C8 is pressed, the display sections are shown on the screen 51 with data of the weft insertion device 2 selected by the color button.

[0029] The line graphs of the total flow rate GQ and of the upper limit flow rate LQ are shown together in the graph display section 56, which allows the loom operator to compare the change of the total flow rate GQ of the current day and the last few days with the upper limit flow rate LQ. As is clear from Fig. 2, the total flow rate GQ remains stable below the upper limit flow rate LQ, which means wasteful consumption of compressed air by the air jet loom 1. The wasteful consumption of compressed air by the air jet loom 1 leads to unnecessary load on the factory air compressor, with the result that the electric power consumption of the air compressor is increased.

[0030] It can be determined from the change of the total flow rate GQ shown in Fig. 2 that the upper limit flow rate LQ can be lowered by the flow rate of X as indicated by arrow, specifically lowered to the level indicated by reference symbol LQ-X in the graph display section 56 of Fig. 2. Pressing the data change button or pressing the part of the upper limit flow rate display section 58 where the upper limit flow rate LQ is shown, the display section of such button is switched to a state which allows rewriting of the data of the upper limit flow rate LQ. Then inputting data of the upper limit flow rate LQ-X using a numerical keypad (not shown), the data LQ-X is shown on the upper limit flow rate display section 58 and also on the graph display section 56 and registered in the controller 40 as the new data of the upper limit flow rate.

[0031] There may occur a change of the initial pressure of compressed air supplied from the factory air compressor. Such pressure change affects the pressure regulation at the main regulator 17 and the sub-regulators 30, 38, thereby causing pressure change in the main air tank 15 and the sub-air tanks 27, 35. Showing the line graph indicative of the change of the initial pressure P on the graph display section 56 together with the line graphs of the total flow rate GQ and the upper limit flow rate LQ helps the loom operator to determine whether or not the upper limit flow rate LQ should be changed and also how much the upper limit flow rate LQ can be lowered while referring to the change of the initial pressure P.

[0032] Figs. 3 and 4 show the case that the change of the total flow rate GQ is different from that in the case of Fig. 2. As shown in Fig. 3, the total flow rate GQ remains stable below the upper limit flow rate LQ for the last three days, but the total flow rate GQ of the current day is increased abnormally to exceed the upper limit flow rate LQ as indicated by reference symbol GQ1. Such abnormal state is shown in the graph display section 56 in the form of a line graph and also in the total flow rate display section 57 in the form of a numerical value. In this case, although not shown in the drawings, the controller 40 transmit a signal which causes an alarm indication on the display 50 and the alarm lamp of the air jet loom 1 to be illuminated.

[0033] In order to find the cause of the abnormally increased total flow rate GQ1, the loom operator having the alarm indication on the controller 40 presses the history button 53 on the screen 51 to change the screen 51 of Fig. 3 to the screen 60 of Fig. 4 showing a history display section 61. The history display section 61 shows changes of various items associated with compressed air in the air jet loom 1, specifically showing the date and time of change, the flow rate, the part of change, and the data before and after the change in the form of a time series table. Referring to the last data of the history or the data of June 5, 10:25, for example, it can be understood that the sub-nozzle pressure has been changed from P4 to P4+ α and such pressure increase has resulted in the sub-nozzle flow rate Q5.

[0034] Checking the changes of various items shown in the history display section 61 makes it easy to locate the cause of the abnormally increased total flow rate GQ1 and whether or not such abnormal state can be corrected. The loom operator can understand that when the abnormally increased total flow rate GQ1 is, for example, due to excessive increase of pressure, the pressure should be reduced to a normal level, and also that when the abnormally increased total flow rate GQ1 is caused, for example, by mistake, the pressure should be reduced to the previous level. Locating and correcting the cause of the abnormality quickly, the total flow rate GQ1 which is abnormally increased above the upper limit flow rate LQ can be lowered to the level of the total flow rate GQ that is below the upper limit flow rate LQ, thereby minimizing unnecessary load on the factory air compressor and

hence wasteful electric power consumption.

[0035] It is to be understood that the present invention is not limited to the above-described embodiment, but it may be modified in various ways as exemplified below without departing from the scope of the invention.

(1) Although in the illustrated embodiment the flow rate of compressed air is calculated from the data of pressure and valve opening, there may be provided in a compressed air supply line a flow rate gauge that measures the compressed air flow rate directly and also serves as the flow rate measuring device of the present invention.

(2) The number of days for showing previous data in the graph display section 56 is not limited to three days as in the case of Figs. 2, 3, but may be four or more days, or several months. The type of graph shown in the graph display section 56 is not limited to a line graph, but may be of any suitable type such as bar graph.

(3) The initial pressure P need not necessarily be shown in the graph display section 56, and the individual data display section 59 shown in Figs. 2, 3 need not necessarily be shown.

(4) Although in the illustrated embodiment the main nozzle 5 and the tandem nozzle 6 are supplied with compressed air of the same pressure, there may be provided in a compressed air supply line for the tandem nozzle 6 an additional regulator and its associated air tank so that compressed air of different pressures is supplied to the main nozzle 5 and the tandem nozzle 6.

(5) The weft insertion device 2 need not necessarily include the tandem nozzle 6, but may include only the main nozzle 5.

(6) The flow rate to be measured and displayed need not necessarily be the total flow rate of compressed air consumed in the air jet loom, but may be part of the flow rate of compressed air consumed in the air jet loom.

(7) It may be configured that in the default setting the screen 51 shows only the graph display section 56, the total flow rate display section 57, the upper limit flow rate display section 58 and the individual data display section 59 are shown as necessary.

(8) The graph display section 56 and the history display section 61 may be shown side-by-side on the same screen.

(9) It may be configured that in the default setting the data of flow rate as shown in the individual data

display section 59 is shown in the graph display section 56 in the form of a graph.

[0036] An apparatus for showing compressed air flow rate in an air jet loom includes a main nozzle and sub-nozzles causing a weft yarn to move by means of compressed air, a flow rate measuring device that serves to measure flow rate of compressed air consumed in the air jet loom, and a controller equipped with a display. The controller causes the display to show a time series graph of the measured flow rate of compressed air together with a time series graph of a previously set upper limit flow rate of compressed air for the air jet loom.

Claims

1. An apparatus for showing compressed air flow rate in an air jet loom, comprising:

a main nozzle (5) and sub-nozzles (3) causing a weft yarn (Y) to move by means of compressed air;

a flow rate measuring device (9, 11, 16, 24, 29, 33, 37, 40) that serves to measure flow rate of compressed air consumed in the air jet loom (1); and

a controller (40) equipped with a display (50), **characterized in that** the controller (40) causes the display (50) to show a time series graph of the measured flow rate of compressed air (GQ) together with a time series graph of a previously set upper limit flow rate of compressed air (LQ) for the air jet loom (1).

2. The apparatus of claim 1, wherein the controller (40) causes the display (50) to show a time series graph of initial pressure of compressed air (P) to be supplied to the air jet loom (1), together with the time series graph of the measured flow rate of compressed air (GQ) and the time series graph of the upper limit flow rate of compressed air (LQ).

3. The apparatus of claim 1 or 2, wherein the controller (40) causes the display (50) to show changes associated with the main nozzle (5) and sub-nozzles (3) in the form of a time series table.

4. The apparatus of any one of claims 1 to 3, wherein plural main nozzles (5) are provided, the controller (40) causes the display (50) to show a time series graph of compressed air consumption of each main nozzle (5).

5. The apparatus of any one of claims 1 to 4, wherein the display (50) has a display section (58) showing data of the upper limit flow rate of compressed air (LQ) as well as functioning as a button to change the

data of the upper limit flow rate of compressed air
(LQ).

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FIG. 1

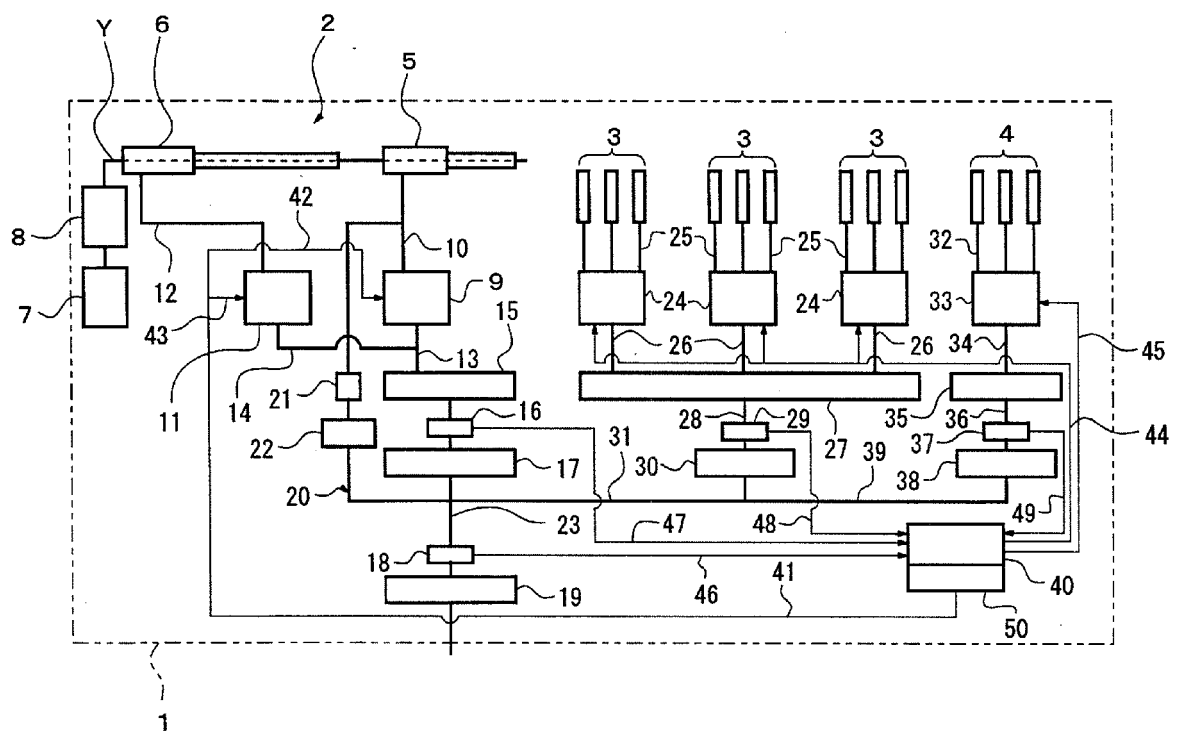


FIG. 2

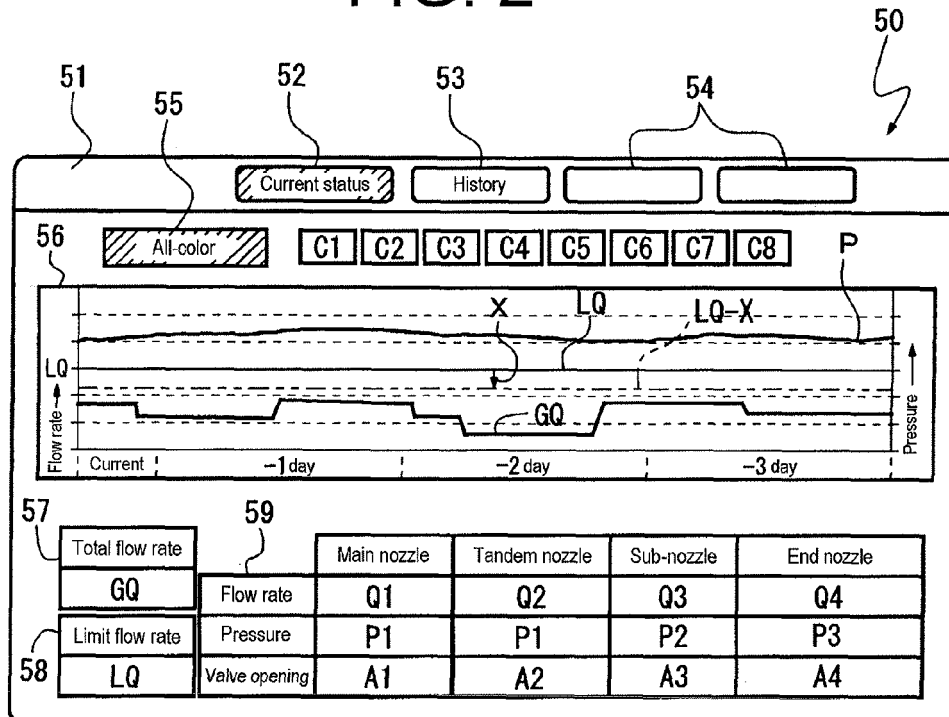


FIG. 3

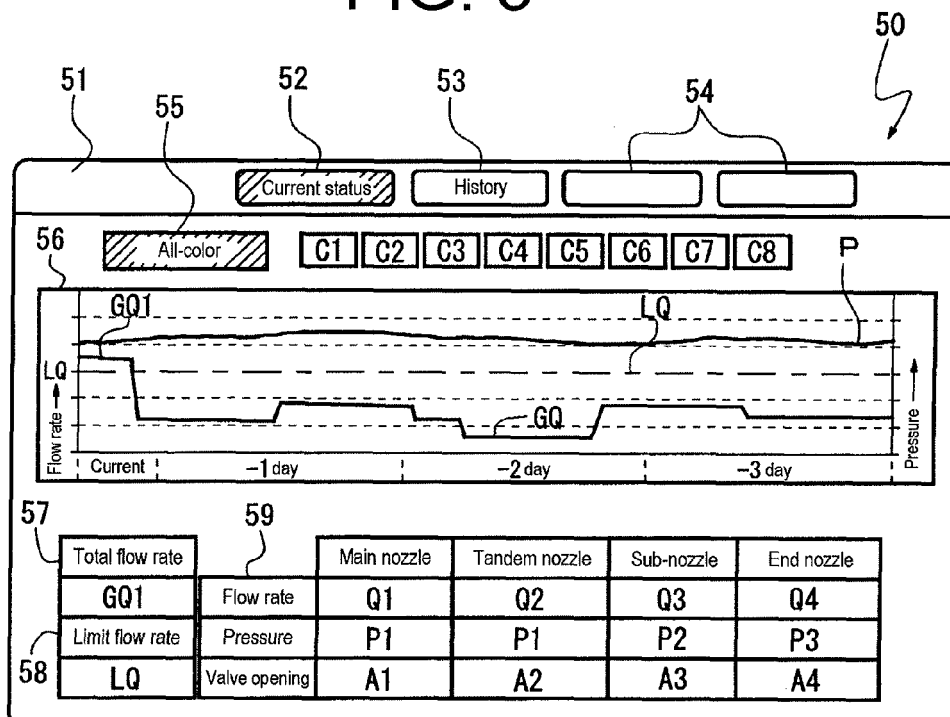
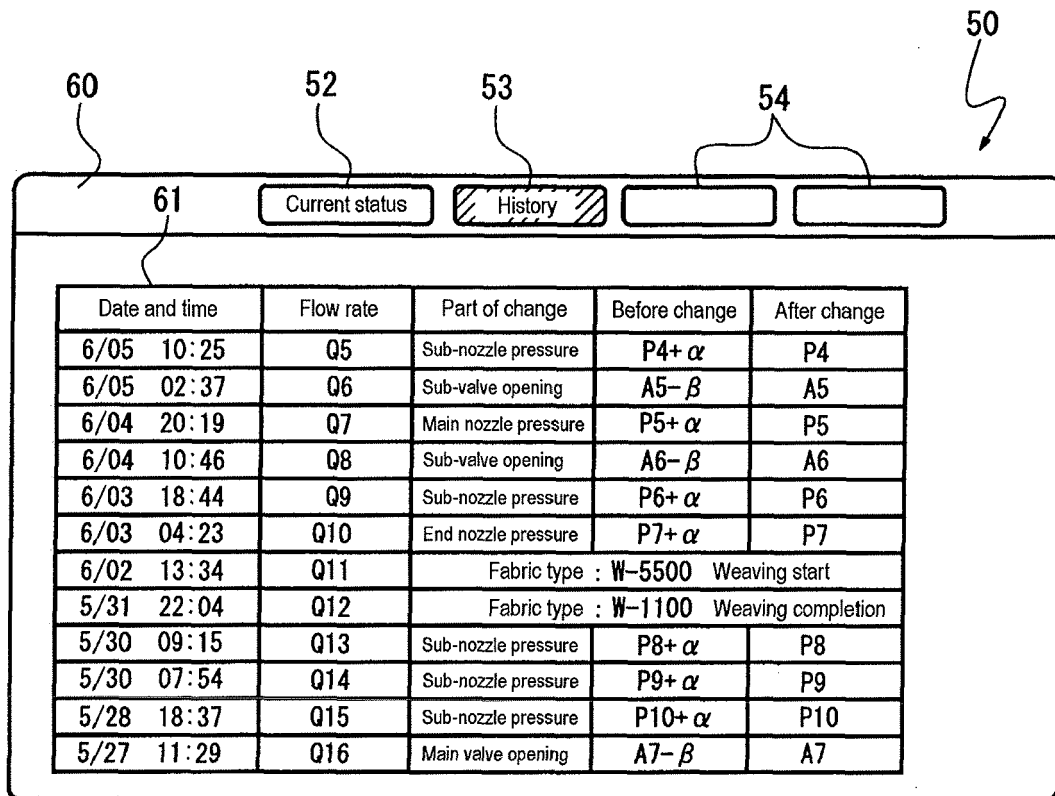


FIG. 4





EUROPEAN SEARCH REPORT

Application Number
EP 13 19 0189

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	WO 2010/046092 A1 (PICANOL NV [BE]; COOPMAN KRIS [BE]; VANDENBROUCKE ANDRE [BE] PICANOL []) 29 April 2010 (2010-04-29) * paragraphs [0011], [0013], [0017], [0018], [0019], [0021], [0024], [0026], [0031], [0032], [0033], [0034], [0036], [0037]; figures 1,2 *	1-5	INV. D03D47/30
A	EP 0 743 384 A2 (TOYODA AUTOMATIC LOOM WORKS [JP] KK [JP]) 20 November 1996 (1996-11-20) * the whole document *	1-5	
A	JP 2002 138346 A (TOYOTA IND CORP) 14 May 2002 (2002-05-14) * abstract; figures 1,2 *	1-5	
A	EP 1 731 645 A2 (SMIT S P A UNIPERSONALE [IT]) 13 December 2006 (2006-12-13) * paragraphs [0006], [0010] - [0017]; figures 1-3 *	1-5	
			TECHNICAL FIELDS SEARCHED (IPC)
			D03D D03J
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 February 2014	Examiner Iamandi, Daniela
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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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 19 0189

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The members are as contained in the European Patent Office EDP file on
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21-02-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2010046092 A1	29-04-2010	BE 1018324 A3	07-09-2010
		CN 102203334 A	28-09-2011
		EP 2352869 A1	10-08-2011
		WO 2010046092 A1	29-04-2010

EP 0743384 A2	20-11-1996	DE 69608852 D1	20-07-2000
		DE 69608852 T2	28-12-2000
		EP 0743384 A2	20-11-1996
		JP H08311744 A	26-11-1996

JP 2002138346 A	14-05-2002	NONE	

EP 1731645 A2	13-12-2006	CN 1876920 A	13-12-2006
		EP 1731645 A2	13-12-2006
		JP 2006342484 A	21-12-2006

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Patent documents cited in the description

- JP 2175956 A [0003]
- WO 2175956 A [0004]