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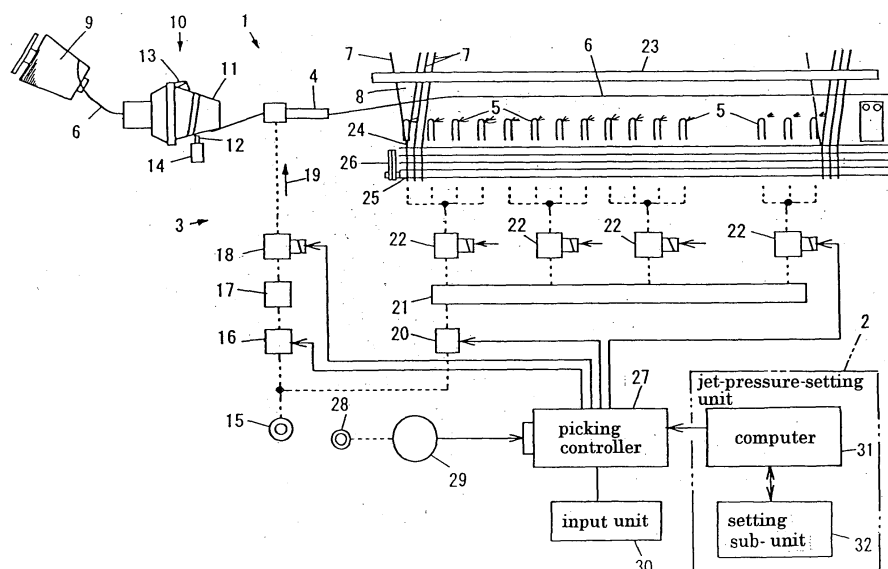
(54) **Method for setting jet-pressures of fluid-jet loom, and jet-pressure-setting unit and picking unit, for use in executing same**

(57) There is provided a method for easily setting jet-pressures of picking nozzles of a fluid-jet loom, respectively, by coping with variation in workpiece in process, particularly, variation in yarn type of a weft yarn in process.

To that end, the method of setting the jet-pressures of the fluid-jet loom, comprises the steps of presetting a plurality of formulas with a picking rate (X) as a variable, for example, a linear equation $V = AX + B$ so as to cor-

respond to respective yarn types of a weft yarn (6) in order to compute recommended set pressure values V of the jet pressure for the picking nozzles (main nozzle 4, and sub-nozzles 5), selecting the formula corresponding to the yarn type of the weft yarn (6) at a time of setting the jet pressure as a picking condition, and computing and outputting the recommended set pressure values V for the picking nozzles (the main nozzle 4, and sub-nozzles 5), respectively, by use of the formula as selected.

FIG. 1



Description

[0001] The present invention relates to a method for setting jet-pressures of picking nozzles of a fluid-jet loom, respectively, and to a jet-pressure-setting unit, and a picking unit, for use in executing the same.

[0002] A fluid-jet loom such as, for example, an air-jet loom has a main nozzle and sub-nozzles and executes picking by jetting in relays compressed air from the respective nozzles. With such a fluid-jet loom as above, it is necessary to set a condition of picking nozzles every time there is a change in fabric type, particularly, the yarn type of a weft yarn, and at such a time, a worker in charge decides on a fluid feeding pressure of the respective nozzles and jetting timing on the basis of past experience or by referring to a setting table while taking into account the traveling characteristic of the weft yarn.

[0003] Meanwhile, JP - A 1987 - 243858 discloses a method comprising the steps of storing information concerning yarns having past weaving records in a memory of a weaving control computer, finding the information on a yarn in process upon weaving, reading out appropriate information as found, corresponding to the yarn from the memory, and setting the weaving condition of a loom based on the appropriate information. Further, JP-A 1988 - 135543 discloses a method comprising the steps of presetting pressures of a jet fluid and jetting timing, corresponding to types of a weft yarn, respectively, in a controller, reading out an appropriate pressure of the jet fluid and jetting timing, corresponding to the type of a weft yarn from the controller, and executing picking on the basis of the pressure of the jet fluid and jetting timing, corresponding to the type of the weft yarn.

[0004] With reference to yarns of a fabric, having no past weaving record, however, there is no choice but to set a picking condition by referring to a manufacturer and so forth, or by trial and error. Particularly, because of the existence of a yarn susceptible to break, an elastic yarn, a yarn hard to travel, and so forth, it is hard to set jet-pressures of nozzles as the picking condition, and further, it takes time to find an optimum set value. As there are times when a trial weaving operation is performed while adjusting the picking condition, it takes time before starting weaving, resulting in deterioration in productivity of a fabric. Under such circumstances, there has existed a problem that time required for setting and adjusting a loom cannot be shortened.

[0005] It is therefore an object of the invention to provide a method for easily setting jet-pressures of picking nozzles of a fluid-jet loom, respectively, by coping with variation in workpiece in process, particularly, variation in yarn type of a weft yarn in process.

[0006] To that end, in accordance with a first aspect of the invention, there is provided a method comprising the steps of presetting a plurality of formulas with a picking rate as a variable so as to correspond to respective yarn types of a weft yarn in order to compute recommended set pressure values of jet pressure for picking

nozzles, selecting the formula corresponding to the yarn type of the weft yarn at a time of setting the jet pressure as a picking condition, and computing and outputting the recommended set pressure values for the picking nozzles, respectively, by use of the formula as selected and the picking rate.

[0007] As described above, the invention is intended for use in a fluid-jet loom, that is, an air-jet loom and a water-jet loom. Accordingly, the picking nozzles for which the pressure values are shown include a main nozzle for drawing out the weft yarn by jetting, an auxiliary main nozzle attached to the main nozzle, and a plurality of sub-nozzles disposed along a traveling path of the weft yarn. The invention is useful particularly when computing set pressure values for the sub-nozzles, respectively

[0008] The picking rate X (m / min) can be found from the product of a length Y of the weft yarn, necessary for picking in one picking cycle and the number Z (rpm) of loom revolutions. Accordingly, the invention is carried out with a mode of operation, using the picking rate X as is as a variable or a mode of operation, using two parameters described as above (the length Y of the weft yarn and the number Z of loom revolutions). For the length Y of the weft yarn, to be picked, use may be made of a length (the product of a drum diameter and the number of unwinding turns per one picking cycle) as measured by, for example, a length measuring and storage unit 10 of a drum type, however, a drafting width (weaving width) of a reed may be substituted for the length Y of the weft yarn.

[0009] The formulas corresponding to the respective yarn types of the weft yarn may include formulas different from each other such as, for example, a formula in the form of a linear function for use in one yarn type, and a formula in the form of an irrational function for use in the other yarn type, or may be formulas in the form of the same function with different coefficients used by the yarn type. The formula described as above may be expressed in the form of a linear function, a quadratic or higher degree function, or a function other than these, for example, an irrational function.

[0010] A preferable formula is a linear equation and may be expressed as $V = AX + B$, using the picking rate X described besides V : the recommended set pressure value for each of the picking nozzles, A , B : coefficients selected so as to correspond to the yarn type of the weft yarn, kinds of the nozzles, and so forth, respectively. Herein because the picking rate X can be found from the product of the length Y of the weft yarn for one picking cycle and the number Z of loom revolutions as previously described, the length Y of the weft yarn and the number Z of the loom revolutions are the parameters related to the picking rate X . Further, the coefficients A , B are found by executing analysis of a data group consisting of picking rates X and the then-set pressures for the picking nozzles, respectively, by use of software. Such analysis is generally executed by regression anal-

ysis for the formula described. Setting of the coefficients A, B is performed on the part of a manufacturer of the loom. However, it is also possible for a user to set the coefficients A, B by accumulating data on the loom on the part of the user and executing the analysis described above.

[0011] Selection of the yarn type of the weft yarn may be further subdivided depending on whether or not a doubling yarn (single yarn, tow-hold yarn) exists, and whether or not processing (elasticity processing, twisting and the number of twists, oiling, and etc.) has been applied besides paying attention to material and thickness (fineness) thereof, and a plurality of the coefficients A, B, respectively, are preferably preset so as to be selectable corresponding thereto.

[0012] Parameters of the formula may include kinds (part numbers) of the nozzles, positions of the nozzles, particularly, setting of pitches and height of the sub-nozzles, parameters related to a traveling path of the weft yarn, such as kinds of the reed, the number of reed tooth, reed tooth density, thickness of a reed teeth, and so forth, besides the two parameters (the length Y of the weft yarn and the number Z of the loom revolutions) matching the picking rate. Such parameters may be added to the two parameters preciously described. By analyzing data groups subdivided by the parameters as added, the coefficients may be preset in plural numbers, respectively, by those parameters, and corresponding coefficients may be selected depending on the parameters as added, respectively, at a time of setting, to thereby compute the recommended set pressure values V. By so doing, the recommended set pressure values V are obtained with higher precision, and it is therefore preferable to do so.

[0013] The recommended set pressure values V for the picking nozzles, found by the formula described above, exactly as outputted, may be automatically set as set values at the time of picking, or may be shown on the display prior to setting so that an operator can execute input-setting as the set values on an interactive basis, depending on the contents of the display. In the case of showing the same on the display, it is possible to display not only the recommended set pressure values V as they are but also upper and lower limits as computed by multiplying the respective recommended set pressure values by a predetermined factor such as safety factor as respective tolerance ranges of the recommended set pressure values V.

[0014] As described hereinbefore, the invention provides means for solving the problems comprising the steps of presetting a plurality of formulas with a picking rate as a variable so as to correspond to respective yarn types of a weft yarn in order to compute recommended set pressure values of jet pressure for picking nozzles for the fluid-jet loom, selecting the formula corresponding to the yarn type of the weft yarn at a time of setting the jet pressure as a picking condition, and computing and outputting the recommended set pressure values

for the picking nozzles, respectively, by use of the formula as selected. Accordingly, since the picking condition, particularly, time required for pressure setting work for the picking nozzles is shortened, so that the loom can be more efficiently operated, resulting in enhancement of productivity for the fabric.

Fig. 1 is a schematic view illustrating a system comprising an embodiment of a jet-pressure-setting unit as well as a picking unit of a fluid-jet loom, according to the invention;

Fig. 2 is a block diagram showing a computer and a setting sub-unit of the jet-pressure-setting unit;

Fig. 3 is a flow chart showing a method for setting jet-pressures of picking nozzles of the fluid-jet loom, respectively;

Fig. 4 is a schematic illustration showing a display screen of a display;

Fig. 5 is a table showing coefficients a, b, corresponding to weft yarn types, respectively;

Fig. 6 is a distribution graph of data used in computation for a regression formula;

Fig. 7 is a distribution graph of data used in computation for a regression formula; and

Fig. 8 is a table for verifying relationship between the recommended set pressure values as computed and actual pressure setting (the set pressure values).

[0015] Fig. 1 is a schematic flow illustration showing the principal parts of a fluid-jet loom 1 together with an embodiment of a jet-pressure-setting unit 2 as well as a picking unit 3 of the fluid-jet loom, according to the invention. In Fig. 1, there is shown an air-jet loom as an example of the fluid-jet loom 1, and a weft yarn 6 is picked into a shed 8 formed with warp yarns 7 by jetting air as a fluid from a main nozzle 4 as well as a plurality of sub-nozzles 5 of the picking unit 3.

[0016] Both the main nozzle 4 and the plurality of the sub-nozzles 5 serve as picking nozzles. The main nozzle 4 is on the picking side, and is directed toward the shed 8 while the plurality of the sub-nozzles 5 are disposed along a traveling path of the weft yarn 6 in the warp shed so as to form a plurality of groups, and are directed toward a traveling direction of the weft yarn 6. Respective jet air pressures of the main nozzle 4 and the plurality of the sub-nozzles 5 are set by the jet-pressure-setting unit 2.

[0017] The weft yarn 6 is drawn out of a yarn package 9 to be guided to a length measuring and storage unit 10 of, for example, a drum type, and is retained on the peripheral surface of a drum 11 in a stationary condition by a retainer pin 12, so that the weft yarn 6 is wound around the drum 11 by rotational move of a rotary yarn guide 13 to be thereby measured in length and stored until a picking point in time. At the picking point in time, the retainer pin 12 is driven by a pin operating device 14 and retracts from the peripheral surface of the drum

11, whereupon the weft yarn 6 wound around the peripheral surface of the drum 11 is drawn out following jetting by the main nozzle 4, and is then unwound on the drum 11 up to a length necessary for only one picking cycle to be thereby guided to the main nozzle 4. Upon the weft yarn 6 being unwound on the drum 11 up to the length necessary for only one picking cycle, the retainer pin 12 retains the weft yarn 6 on the drum 11, thereby terminating picking this time.

[0018] Compressed air 19 is fed from a compressed air source 15 to the main nozzle 4 via a pressure regulator 16, an air storage tank 17, and an electromagnetic switching valve 18, and because the electromagnetic switching valve 18 is opened and closed at predetermined picking timing, the main nozzle 4 picks the weft yarn 6 up to the length necessary for only one picking cycle along with a jet air flow into the shed 8 formed with the warp yarns 7 by jetting the compressed air 19 into the shed 8. Further, the compressed air 19 is fed from the compressed air source 15 to the plurality of the sub-nozzles 5 in the respective groups via a pressure regulator 20, an air storage tank 21, and electromagnetic switching valves 22, and because the electromagnetic switching valves 22 are opened and closed at the predetermined picking timing, the plurality of the sub-nozzles 5 in the respective groups urge the weft yarn 6 traveling in the shed 8 to move in a picking direction by jetting the compressed air 19 in unison or by relay toward the traveling direction of the weft yarn 6. A portion of the weft yarn 6, normally picked, is beaten up into a cloth fell 24 by a reed 23 to form a fabric 25, and is cut on the picking side by a yarn cutter 26 to be thereby separated from the rest of the weft yarn 6, remaining in the main nozzle 4.

[0019] The pressure regulators 16, 20 and the electromagnetic switching valves 18, 22 are controlled by a picking controller 27.

[0020] The picking controller 27 receives signals for recommended set pressure values V from the jet-pressure-setting unit 2, and sends out pressure command signals corresponding to the recommended set pressure values V, respectively, to the pressure regulators 16, 20, respectively, to thereby set appropriate pressures for the picking nozzles while receiving a rotation angle signal from a rotation detector 29 linked with a main shaft 28, and controlling the picking condition as set by an input unit 30, particularly, opening and closing timing (jetting start timing and jetting termination timing) of the electromagnetic switching valve 18 and the plurality of the electromagnetic switching valves 22, respectively, on the basis of jetting start and jetting termination timing of the main nozzle 4 and the plurality of the sub-nozzles 5, respectively. The pressure regulators 16, 20 and the picking controller 27 make up a pressure control system.

[0021] The jet-pressure-setting unit 2 comprises a setting sub-unit 32 and a computer 31. The operator operates the setting sub-unit 32 to input parameters relat-

ed to a picking rate X and information related to yarn types of the weft yarn 6. The setting sub-unit 32 sends out such input information to the computer 31.

[0022] The computer 31 holds a plurality of formulas in order to compute the respective recommended set pressure values V of jet-pressures for the main nozzle 4 and the plurality of the sub-nozzles 5, serving as the picking nozzles, and selects a formula corresponding to the yarn type of the weft yarn 6 from among the plurality of the formulas at a time of setting the jet-pressures for the main nozzle 4 and the plurality of the sub-nozzles 5, respectively, while computing the respective recommended set pressure values V for the main nozzle 4 and the plurality of the sub-nozzles 5 on the basis of the parameters as inputted by use of the formula as selected before outputting the same to the picking controller 27. The picking controller 27 generates the pressure command signals corresponding to the recommended set pressure values V, respectively, on the basis of the recommended set pressure values V, and sends out the same to the pressure regulators 16, 20, respectively, thereby controlling the jet-pressures for the main nozzle 4 and the plurality of the sub-nozzles 5, respectively.

[0023] The formula described as above can be expressed in the form of a linear function, a quadratic or higher degree function, or a function other than these, for example, an irrational function. A preferable formula is a linear equation because it is simple and easy to process, and can be expressed as $V = AX + B$ where V is a recommended set pressure value for each of the picking nozzles, A, B are coefficients selected so as to correspond to the yarn type of a weft yarn, respectively, and X is a picking rate.

[0024] Herein because the picking rate X can be found from the product of a length Y of a weft yarn for one picking cycle and the number Z of loom revolutions, the length Y of a weft yarn and the number Z of the loom revolutions are the parameters related to the picking rate X. Further, the coefficients A, B can be found by executing analysis of a data group consisting of picking rates X and the then-set pressures for the picking nozzles, respectively, by use of software. Such analysis is generally executed by regression analysis for the formula described. Selection of the yarn type of the weft yarn 6 can be further subdivided depending on whether or not a doubling yarn (single yarn, tow-hold yarn) exists, and whether or not processing (elasticity processing, twisting and the number of twists, oiling, and etc.) has been applied besides paying attention to material and thickness (fineness) while setting of the coefficients A, B is normally performed on the part of a manufacturer of the loom. However, it is also possible for a user to set the coefficients A, B through the intermediary of the setting sub-unit 32, and so forth, by accumulating data on the loom on the part of the user and by executing the analysis described above. Specific techniques for the regression analysis of the formula are described later with reference to Figs. 5 and 6.

[0025] Fig. 2 is a block diagram showing the jet-pressure-setting unit 2 of the fluid-jet loom 1. The jet-pressure-setting unit 2 comprises the computer 31 and the setting sub-unit 32. The setting sub-unit 32 has a card I/F 36 of a memory card 37, a display 38, and an input setting device 39, such as a keyboard and so forth, in order to input the parameters (the length Y of the weft yarn and the number Z of the loom revolutions) related to the picking rate X and information related to the yarn types of the weft yarn 6, and these components are connected with each other via an I/O port 35 inside the computer 31 in a state allowing bidirectional communication therebetween. Further, a display screen of the display 38 is made up of a so-called touch panel, doubling for part of the functions of the input setting device 39.

[0026] The computer 31 comprises a CPU 33 and a memory 34 besides the I/O port 35, and the memory 34 stores a program for computing the recommended set pressure values V for the picking nozzles, other programs as inputted via the memory card 37, and a program for computing the recommended set pressure values V to be renewed by the memory card 37. The CPU 33 executes the program for computing the recommended set pressure values V for the picking nozzles, as read out of the memory 34, and outputs the recommended set pressure values V as computed to the picking controller 27, additionally executing renewal / change of storage contents of the memory 34, control for displaying the recommended set pressure values V as computed by operating the display 38, and control for processing information as inputted from the input setting device 39.

[0027] Fig. 3 is a flow chart showing the steps of executing the program for computing the recommended set pressure values V for the picking nozzles. The CPU 33 reads out the program for computing the recommended set pressure values V for the picking nozzles out of the memory 34, and executes the program. In the initial step after the start, the program first issues a prompt for selective input of the yarn type of the weft yarn 6, and input of the parameters (the length Y of the weft yarn and the number Z of the loom revolutions) related to the picking rate X.

[0028] Hereupon, the operator inputs and selects information as required via the setting sub-unit 32. The yarn type of the weft yarn is set by selecting one from among a plurality of yarn types of the weft yarn 6, pre-registered on the part of a manufacturer, shown on the display screen of the display 38. For such selective setting, the plurality of the yarn types of the weft yarn 6 are pre-registered in the memory 34 on the part of the manufacturer. As a result of such selection, the CPU 33 reads out the coefficients A, B, required for computation of the recommended set pressure values V, from the memory 34.

[0029] The length Y of the weft yarn and the number Z of the loom revolutions can be set by operating the input setting device 39 to thereby enter numerical values

into corresponding columns on the display screen, respectively. The length Y of the weft yarn can be computed by multiplying the number of weft yarn unwinding on the length measuring and storage unit 10 per one picking cycle by the circumference of the drum 11, or a drafting width of the reed, in widespread use among manufacturers, even though not fully accurate, may be substituted for the length Y of the weft yarn. Other picking condition setting includes setting of, for example, the number of the groups of the sub-nozzles 5, the number of the sub-nozzles in one group, disposition pitches of the sub-nozzles 5 in the respective groups, and so forth, however, these are not utilized for the computation of the recommended set pressure values V

[0030] In the next step, the operator designates a mode of calculation operation by operating a pressure calculation button or an automatic pressure setting button of the input setting device 39, or operating a touch key for "recommended pressure value calculation" or a touch key for "automatic pressure setting" on the display screen of the display 38, thereby causing the CPU 33 to start calculation of the recommended set pressure values V for the picking nozzles. Thereupon, the CPU 33 executes operation of the previously described formula $V = AX + B$ by use of the coefficients A, B and the picking rate X to thereby compute the recommended set pressure value V for the main nozzle 4 and the recommended set pressure value V common to the sub-nozzles 5 in all the groups or the recommended set pressure value V for the sub-nozzles 5 in the respective groups. Further, the CPU 33 regards respective ranges obtained by multiplying the respective recommended set pressure values by a predetermined safety factor S as respective tolerance ranges of the recommended set pressure values V, as necessary. Incidentally, the safety factor S is decided taking into account the yarn type, given so as to be at a value common to the main nozzle 4 and all the sub-nozzles 5 or at a value specific to the main nozzle 4 and a value specific to the sub-nozzles 5 in the respective groups. Further, the tolerance ranges are decided specifically in a range of $\pm$ several to ten and several %.

[0031] In a subsequent step, the CPU 33 sends out the recommended set pressure values V as computed and the respective tolerance ranges of the recommended set pressure values V, computed as necessary, to the display 38, thereby displaying numerical values thereof by the main nozzles 4 and by the respective sub-nozzles 5. Thus the operator can visually check the respective recommended set pressure values V and the respective tolerance ranges thereof through the display 38.

[0032] In the following step, the CPU 33 checks the operation state of the pressure calculation button or the automatic pressure setting button by executing the program. If automatic setting is not designated (No), the CPU 33 terminates by executing the program, whereupon the operator refers to display contents, and inputs

pressure values into corresponding columns on the display screen of the display 38, respectively, by means of the input setting device 39 to thereby set the same. Meanwhile if the automatic setting is designated (Yes), the CPU 33 determines that the recommended set pressure value V for the main nozzle 4 and the recommended set pressure value V for the sub-nozzles 5 as computed are set pressure values, and outputs the pressure command signals corresponding to the set pressure values, respectively, to the picking controller 27.

[0033] Then, the picking controller 27 operates the pressure regulators 16, 20, respectively, thereby adjusting the respective set pressure values for the main nozzle 4 and the sub-nozzles 5. As previously described, adjustment of the pressure regulators 16, 20 is carried out in common with all the pressure regulators 16, 20, or by each of the pressure regulator 16 and the pressure regulators 20.

[0034] Fig. 4 is a schematic illustration showing the display screen (basic setting: weft) of the display 38 by way of example. On the display screen of (basic setting: weft), there are displayed numerical values based on inputs or the results of computations, for the yarn type of a weft yarn, the number of unwinding, main pressure (for main nozzle jetting), and sub-pressure (for sub-nozzle jetting), corresponding to respective weft picking device number (C1, C2, C3, C4), and for the number of sub-nozzle groups, drafting width of a reed, the number of loom revolutions, subpitch as the setting pitches of sub-nozzles, and the number of sub-nozzles, respectively. In addition, there are also displayed touch keys for "changeover", "main TMG (timing)", "sub TMG", "recommended pressure value calculation", and "automatic pressure setting", respectively.

[0035] The operator designates a mode of operation by touching the touch key for "recommended pressure value calculation", or "automatic pressure setting" instead of operating the pressure calculation button or the automatic pressure setting button of the input setting device 39. The rest of the touch keys, for "changeover", "main TMG (timing)", "sub TMG", are for changing over to other set screens, setting the jet timing of the main nozzle 4 and setting the jet timing of the sub-nozzles 5, respectively. Example of Regression Analysis

[0036] The coefficients A, B can be found by executing regression analysis as follows. The inventor made use of several-jet looms manufactured by the company with whom the inventor is associated and accumulated data on set pressures for sub-nozzles as an example of the picking nozzles, and picking rates (drafting widths of a reed as lengths of a weft yarn, per one picking cycle, and the number of loom revolutions) by the weft yarn type with the air-jet loom kept in the stable operating condition, subsequently executing the regression analysis for every yarn type by use of a regression formula of linear function, $y = ax + b$ where y is a set pressure value, x is a picking rate, and a, b are coefficients, respectively

[0037] Fig. 5 is a table showing the coefficients a, b, in the linear regression formula, as obtained correspondingly to respective weft yarn types as a result of experiments. Herein the coefficients a, b correspond to the coefficients A, B in the previously described formula. Further, Figs. 6 and 7 are distribution graphs of the data used in computation with reference to the upper two rows (marked by "*" outside the last column) in the table of Fig. 5, as an example, respectively, and a straight line in each of the distribution graphs corresponds to the linear regression formula $y = ax + b$, representing a multitude of the data. In the formula, y, x correspond to the recommended set pressure value V, the picking rate X, respectively. In this connection, the regression formula is not limited to that of the linear function.

[0038] Fig. 8 is a table for verifying relationship between the recommended set pressure values as computed and actual pressure setting (the set pressure values) when varying the number of loom revolutions in three stages in order to pick a single yarn as the weft yarn 6 of cotton yarn count No. 40 with a drafting width 170 cm of a reed in the case of an air-jet loom. It has been confirmed from the table that a difference between the recommended set pressure value and the actual pressure setting (the set pressure value) is not more than 0.05 (Mpa) in any case.

[0039] With the embodiment described in the foregoing, one unit of the pressure regulator 20 for the plurality of the sub-nozzles 5 is provided for all the groups of the sub-nozzles 5, but one unit thereof may be provided for a plurality of the groups, respectively, or for the respective groups. Accordingly, so as to correspond thereto, a plurality of the formulas for the recommended set pressure values V need to be set for the plurality of the groups, respectively, or for the respective groups.

[0040] Further, application of the invention is not limited to the main nozzle 4 and the sub-nozzles 5 and the invention is applicable to other picking nozzles as well, for example, an auxiliary main nozzle attached to the main nozzle. Numerical analysis of data groups on a relation between the setting of the picking rate X and pressures by the yarn types of the weft yarn 6 may be executed as for the main nozzle 4 and the auxiliary main nozzle as well to thereby compute the coefficients A, B, which may be stored.

[0041] The invention is applicable to a water-jet loom as well besides the air-jet loom, and is further applicable to a multicolor picking loom as well. In the case where different pressures for the picking nozzles are set by the yarn types of the weft yarn 6, it need only be sufficient to display a recommended set pressure value V by the yarn type.

[0042] In Fig. 1, use is made of the pressure regulators 16, 20 such as an electric-air proportional valve for setting a pressure by receiving a signal, however, the picking unit 3 can be made up of pressure regulators 16, 20 that are mechanically operated without receiving an electrical signal. In the case of the pressure regulators

16, 20 that are mechanically operated, the operator is to operate the pressure regulators 16, 20 while checking a reading of a pressure gage in accordance with the display of the recommended set pressure values and tolerance ranges to thereby set the pressure. Otherwise, the picking unit 3 may be configured such that the pressure is indirectly adjusted by controlling a flow rate with the use of a throttle valve in place of the pressure regulators 16, 20, mechanically operated.

[0043] The recommended set pressure values V may be displayed by the yarn types of the weft yarn 6, or a standing jet pressure for the main nozzle and a cutting pressure also can be displayed. The standing jet pressure means a pressure for jetting air in order to prevent yarn cast-off from the main nozzle 4 regardless of whether an air-jet loom is in operation or out of operation. Further, the cutting pressure means a pressure for preventing repulsion of the weft yarn 6 at a time of cutting thereof by jetting a small amount of air from the main nozzle when cutting the weft yarn 6 with the yarn cutter 26 at a time close to beat-up timing of an air-jet loom.

[0044] In accordance with a first aspect of the present invention, there is provided a method of setting jet-pressures of a fluid-jet loom, comprising the steps of presetting a plurality of formulas with a picking rate as a variable so as to correspond to respective yarn types of a weft yarn in order to compute recommended set pressure values of jet pressure for picking nozzles for the fluid-jet loom, selecting the formula corresponding to the yarn type of the weft yarn at a time of setting the jet pressure as a picking condition, and computing and outputting the recommended set pressure values for the picking nozzles, respectively, by use of the formula as selected and the picking rate. Accordingly, since the picking condition, particularly, the respective set pressures for the picking nozzles are set by the yarn type of the weft yarn and the picking rate of the yarn type with the use of numerical values reflecting the past weaving records, time required for pressure setting work for the picking nozzles is shortened, so that the loom can be more efficiently operated, resulting in enhancement of productivity for the loom.

[0045] Preferably, the formula is a linear function formula, $V = AX + B$, using V as the respective recommended set pressure values for the picking nozzles, A, B as coefficients selected so as to correspond to the yarn type of the weft yarn, respectively, and X as the picking rate. Accordingly, the respective recommended set pressure values V for the picking nozzles are found by a simple operation, and furthermore, the regression formula can be set with ease from the data based on the experiments.

[0046] The picking rate X may be found from the product of the number Z of loom revolutions, and a length Y of the weft yarn, for one picking cycle. Accordingly, the yarn type of the weft yarn and the number Z of loom revolutions can be reflected in the picking rate X.

[0047] Preferably, the picking nozzles comprise a plu-

ality of sub-nozzles provided along a traveling path of the weft yarn to thereby set the respective jet-pressures of the plurality of the sub-nozzles. Accordingly, against the sub-nozzles for which evaluation on whether jet-pressure-setting is appropriate or not is hard to make, an appropriate value can be set with ease. It is generally sufficient to set the picking condition for the main nozzle such that weft yarn arrival timing coincides with a time when a target arrival angle is, for example, at 230° , and the jetting timing and jet pressure can be easily set by watching such a condition. In contrast, in the case of setting the jet-pressures for the sub-nozzles, nothing to serve as a guide for adjustment is available, thus rendering the setting hard to make. Whether or not the set pressure value is appropriate, such as, particularly, the presence or absence of loosening of the weft yarn, break thereof, and so forth, is unknown before actually weaving over a predetermined time period. Further, there is also a problem in that to the extent that the number of the sub-nozzles is large, consumption of air as a fluid for picking increases, and if the pressure thereof is set on a higher side, picking is ensured although the fluid for picking is wasted. Thus, the invention has a large advantageous effect in practical use in that appropriate jet-pressures can be set for the sub-nozzles.

[0048] Further, the respective recommended set pressure values as computed are preferably delivered in display. Accordingly, results of calculation based on the formula can be checked, so that it is possible to recognize respective jet-pressures to be set manually or respectively automatically set jet-pressures, thereby providing assistance for subsequent adjustment.

[0049] Further, respective ranges obtained by multiplying the respective recommended set pressure values as computed based on the formula by a predetermined safety factor may be displayed as respective tolerance ranges of the recommended set pressure values. Accordingly, the tolerance ranges can be checked, so that it is possible to enhance flexibility of setting within the tolerance ranges.

[0050] Still further, a pressure control system may be automatically set with the respective recommended set pressure values as computed as set values. Accordingly, labor-saving is achieved in setting.

[0051] The present invention provides in its second aspect a jet-pressure-setting unit of a fluid-jet loom for picking a weft yarn by jetting a fluid from picking nozzles, said jet-pressure-setting unit comprising a setting sub-unit for inputting parameters related to a picking rate X and information related to yarn types of the weft yarn, and a computer holding a plurality of formulas preset so as to correspond to the respective yarn types of the weft yarn with the picking rate as a variable in order to compute recommended set pressure values of jet-pressures for the picking nozzles, respectively, and selecting the formula corresponding to the yarn type of the weft yarn from among the plurality of the formulas at a time of setting the jet-pressures as a picking condition while com-

putting the recommended set pressure values for the picking nozzles, respectively, on the basis of the parameters as inputted by use of the formula as selected before outputting. With the jet-pressure-setting unit of the fluid-jet loom, since the picking condition, particularly, the respective set pressures for the picking nozzles are set by the yarn type of the weft yarn and the picking rate of the yarn type on the basis of past data, time required for pressure setting work for the picking nozzles is shortened, so that the loom can be more efficiently operated, resulting in enhancement of productivity for the loom.

[0052] Further, the present invention provides in its third aspect a picking unit of a fluid-jet loom for picking a weft yarn by jetting a fluid from picking nozzles, said picking unit comprising a setting sub-unit for inputting parameters related to a picking rate X and information related to yarn types of the weft yarn, and a computer holding a plurality of formulas preset so as to correspond to the respective yarn types of the weft yarn with the picking rate as a variable in order to compute recommended set pressure values of jet-pressures for the picking nozzles, respectively, and selecting the formula corresponding to the yarn type of the weft yarn from among the plurality of the formulas at a time of setting the jet-pressures as a picking condition while computing the recommended set pressure values for the picking nozzles, respectively, on the basis of the parameters as inputted by use of the formula as selected before outputting, a picking controller for generating pressure command signals corresponding to the recommended set pressure values, respectively, outputted from the computer, and pressure regulators for adjusting the jet-pressures of a compressed fluid fed to the picking nozzles, respectively, in accordance with the respective pressure command signals from the picking controller. With the picking unit of the fluid-jet loom, an additional effect is obtained in that the jet-pressures of the compressed fluid fed to the picking nozzles, respectively, are automatically adjusted by the picking controller and the pressure regulators correspondingly to the respective recommended set pressure values outputted from the computer, so that labor-saving is achieved in setting. The picking unit of the fluid-jet loom may further comprise a display for displaying the respective recommended set pressure values outputted from the computer. As a result, it is possible to visually check the results of calculation based on the formula, thereby providing assistance for subsequent adjustment.

Claims

1. A method of setting jet-pressures of a fluid-jet loom, comprising the steps of:

presetting a plurality of formulas with a picking rate (X) as a variable so as to correspond to respective yarn types of a weft yarn (6) in order

to compute recommended set pressure values V of jet pressure for picking nozzles (4, 5); selecting the formula corresponding to the yarn type of the weft yarn (6) at a time of setting the jet pressure as a picking condition; and computing and outputting the recommended set pressure values V for the picking nozzles (4, 5), respectively, by use of the formula as selected and the picking rate (X).

2. A method of setting jet-pressures of a fluid-jet loom, according to claim 1, wherein the formula is a linear function formula, $V = AX + B$, using V as the respective recommended set pressure values for the picking nozzles, A, B as coefficients selected so as to correspond to the yarn type of the weft yarn, respectively, and X as the picking rate.
3. A method of setting jet-pressures of a fluid-jet loom, according to claim 2, wherein the picking rate (X) is found from the product of the number Z of loom revolutions, and a length Y of the weft yarn, for one picking cycle.
4. A method of setting jet-pressures of a fluid-jet loom, according to any of claims 1 to 3, wherein the picking nozzles comprise a plurality of sub-nozzles (5) provided along a traveling path of the weft yarn.
5. A method of setting jet-pressures of a fluid-jet loom, according to any of claims 1 to 4, wherein the respective recommended set pressure values V as computed are delivered in display.
6. A method of setting jet-pressures of a fluid-jet loom, according to claim 5, wherein respective ranges obtained by multiplying the respective recommended set pressure values V as computed by a predetermined safety factor S are displayed as respective tolerance ranges of the recommended set pressure values V
7. A method of setting jet-pressures of a fluid-jet loom, according to any of claims 1 to 6, wherein a pressure control system (16, 20, 27) is automatically set with the respective recommended set pressure values V as computed as set values.
8. A jet-pressure-setting unit (2) of a fluid-jet loom (1) for picking a weft yarn (6) by jetting a fluid from picking nozzles (4, 5), said jet-pressure-setting unit (2) comprising:

a setting sub-unit (32) for inputting parameters related to a picking rate X and information related to yarn types of the weft yarn (6); and a computer (31) holding a plurality of formulas preset so as to correspond to the respective

yarn types of the weft yarn (6) with the picking rate as a variable in order to compute recommended set pressure values V of jet-pressures for the picking nozzles (4, 5), respectively, and selecting the formula corresponding to the yarn type of the weft yarn (6) from among the plurality of the formulas at a time of setting the jet-pressures as a picking condition while computing the recommended set pressure values V for the picking nozzles (4, 5), respectively, on the basis of the parameters as inputted by use of the formula as selected before outputting.

9. A picking unit (3) of a fluid-jet loom (1) for picking a weft yarn (6) by jetting a fluid from picking nozzles (4, 5), said picking unit (3) comprising:

a setting sub-unit (32) for inputting parameters related to a picking rate X and information related to yarn types of the weft yarn (6);
 a computer (31) holding a plurality of formulas preset so as to correspond to the respective yarn types of the weft yarn (6) with the picking rate as a variable in order to compute recommended set pressure values V of jet-pressures for the picking nozzles (4, 5), respectively, and selecting the formula corresponding to the yarn type of the weft yarn (6) from among the plurality of the formulas at a time of setting the jet-pressures as a picking condition while computing the recommended set pressure values V for the picking nozzles (4, 5), respectively, on the basis of the parameters as inputted by use of the formula as selected before outputting;
 a picking controller (27) for generating pressure command signals corresponding to the recommended set pressure values V, respectively, outputted from the computer (31); and
 pressure regulators (16, 20), for adjusting the jet-pressures of a compressed fluid (19) fed to the picking nozzles (4, 5), respectively, in accordance with the respective pressure command signals from the picking controller (27).

10. A picking unit (3) of a fluid-jet loom (1) for picking a weft yarn (6) by jetting a fluid from picking nozzles (4, 5), said picking unit (3) comprising:

a setting sub-unit (32) for inputting parameters related to a picking rate X and information related to yarn types of the weft yarn (6);
 a computer (31) holding a plurality of formulas preset so as to correspond to the respective yarn types of the weft yarn (6) with the picking rate as a variable in order to compute recommended set pressure values V of jet-pressures for the picking nozzles (4, 5), respectively, and selecting the formula corresponding to the yarn

type of the weft yarn (6) from among the plurality of the formulas at a time of setting the jet-pressures as a picking condition while computing the recommended set pressure values V for the picking nozzles (4, 5), respectively, on the basis of the parameters as inputted by use of the formula as selected before outputting;
 a picking controller (27) for generating pressure command signals corresponding to the recommended set pressure values V, respectively, outputted from the computer (31);
 pressure regulators (16, 20), for adjusting the jet-pressures of a compressed fluid (19) fed to the picking nozzles (4, 5), respectively, in accordance with the respective pressure command signals from the picking controller (27); and
 a display (38) for displaying the respective recommended set pressure values V outputted from the computer (31).

FIG. 1

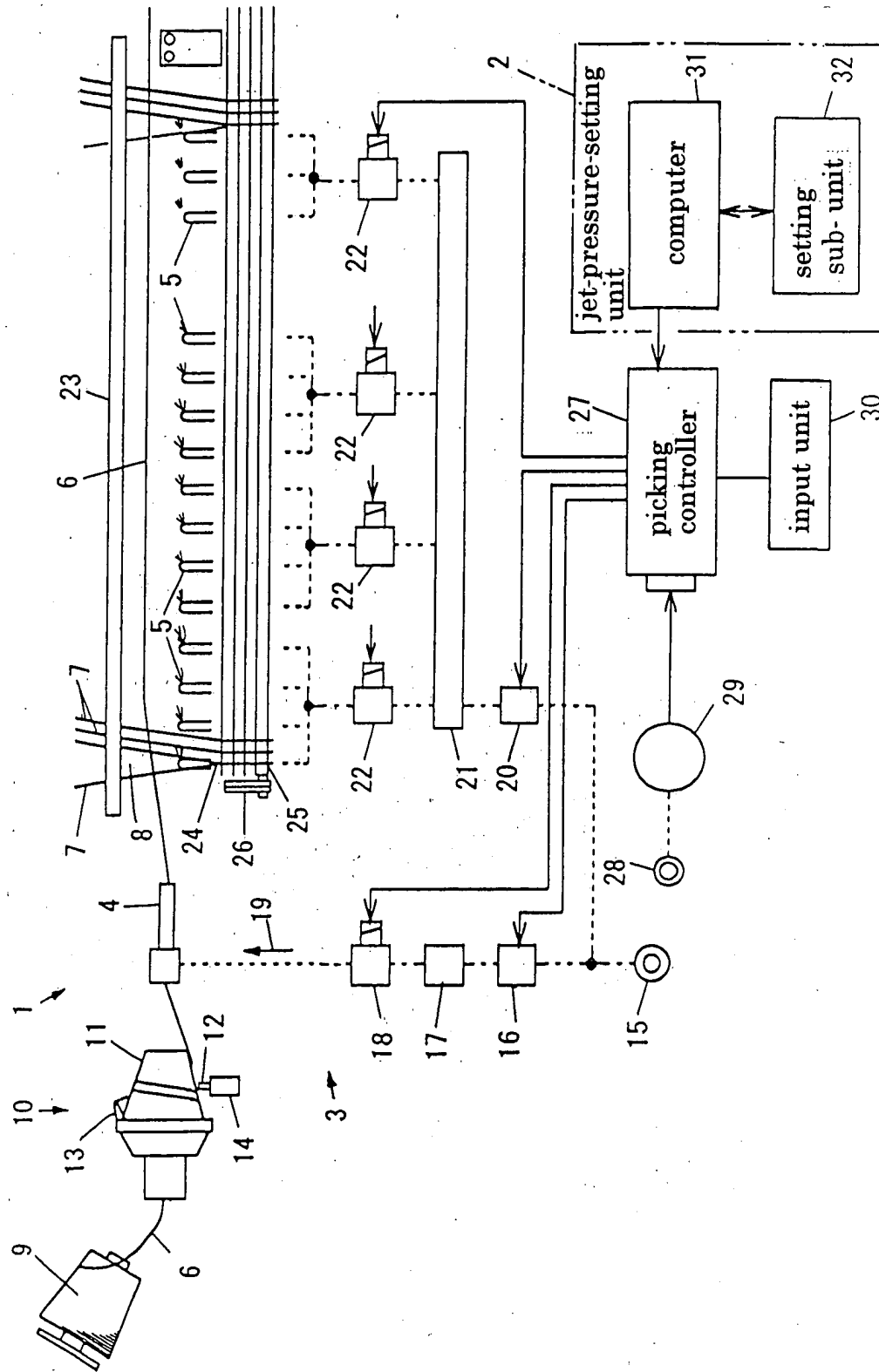


FIG. 2

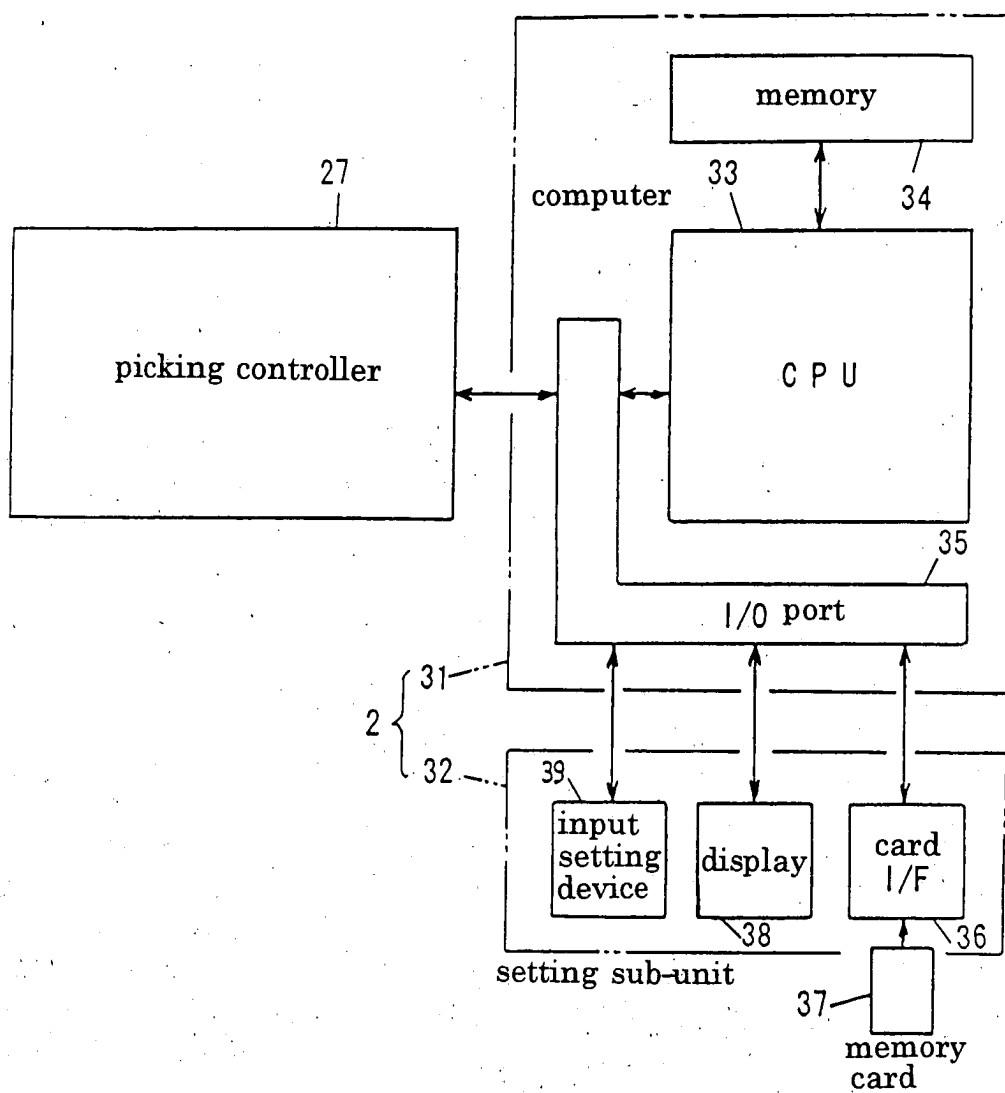


FIG. 3

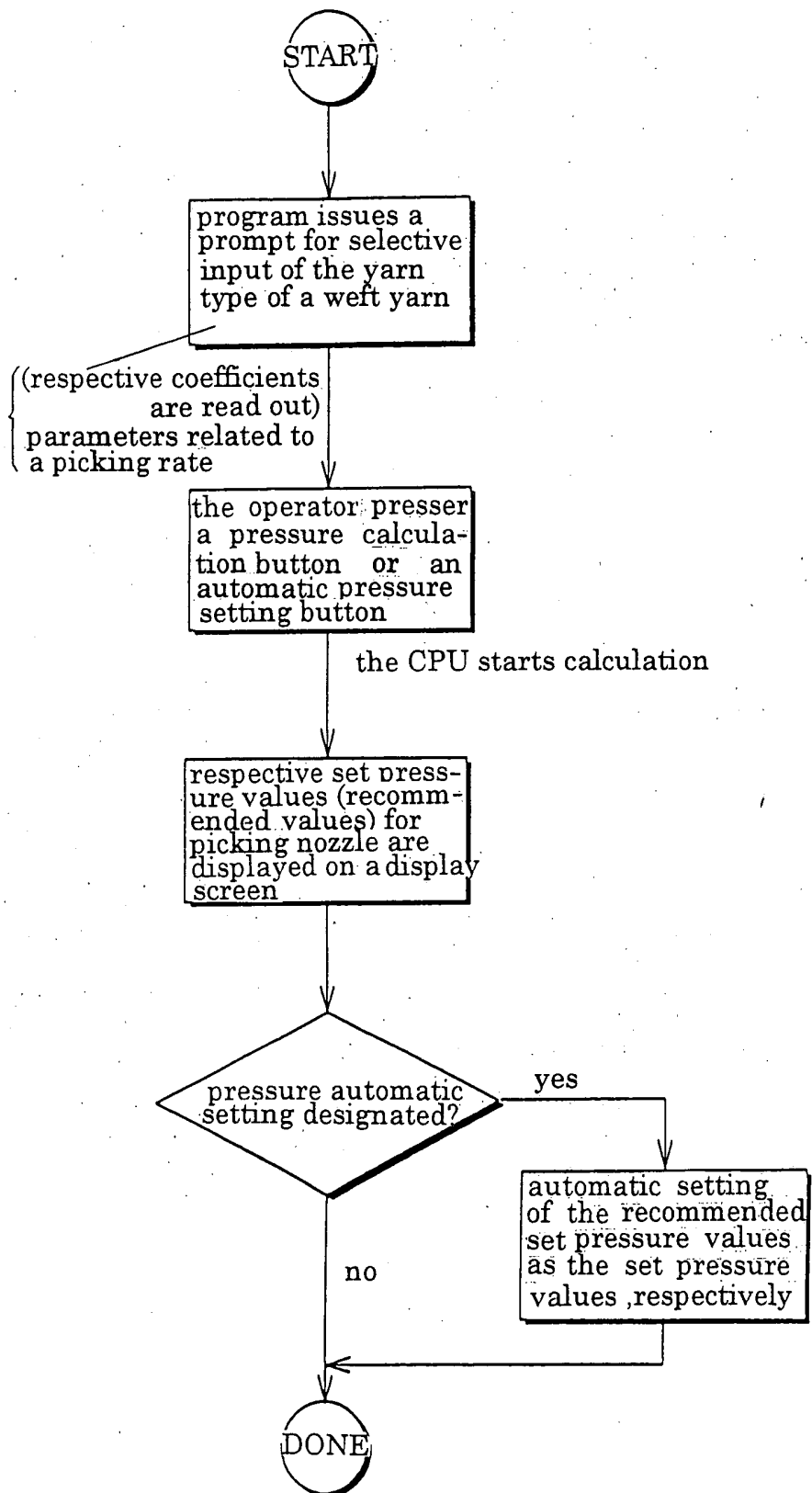


FIG. 4

basic setting weft					
picking device number	weft yarn type	the number of releasing	main pressure(MPa)	sub-pressure(MPa)	
C 1 :	cotton 40/1S▲	3			
C 2 :	cotton 40/1S▲	3			
C 3 :	▲				
C 4 :	▲				
the number of sub-nozzle groups	8	drafting width of a reed	170 (cm)	the number of loom revolutions (rpm)	800
sub-nozzle pitch(mm)	the number of sub-nozzle	sub-nozzle pitch(mm)	the number of sub-nozzle	sub-nozzle pitch(mm)	the number of sub-nozzle
1-1:	4 5	5	1-4:	4 5	5
1-2:	4 5	5	1-5:	4 5	5
1-3:	4 5	5	1-6:	4 5	5
			1-7:	4 5	5
			1-8:	4 5	3
			1-9:		

changeover main TMG sub TMG recommended pressure value calculation automatic setting of pressure

FIG. 5

weft yarn type		coefficient a	coefficient b	
cotton single yarn	thick yarn (cotton count numbers 20~29)	0.0001650	0.1755	*
cotton single yarn	medium yarn count (cotton count numbers 30~40)	0.0001488	-0.1800	*
cotton single yarn	thin yarn count (cotton count numbers 41~59)	0.0002178	0.09974	
wool single yarn	medium yarn count (count numbers 20~39)	0.00007500	0.2780	
wool two-hold yarn	medium yarn count (equivalent to count numbers 20~39)	0.0002640	0.1174	
polyester	medium yarn count (56dtex~125dtex) no twist	0.00009467	0.2953	
polyester	medium yarn count (56dtex~110dtex) loose twist(~1000T/m)	0.0001011	0.3620	

FIG. 6

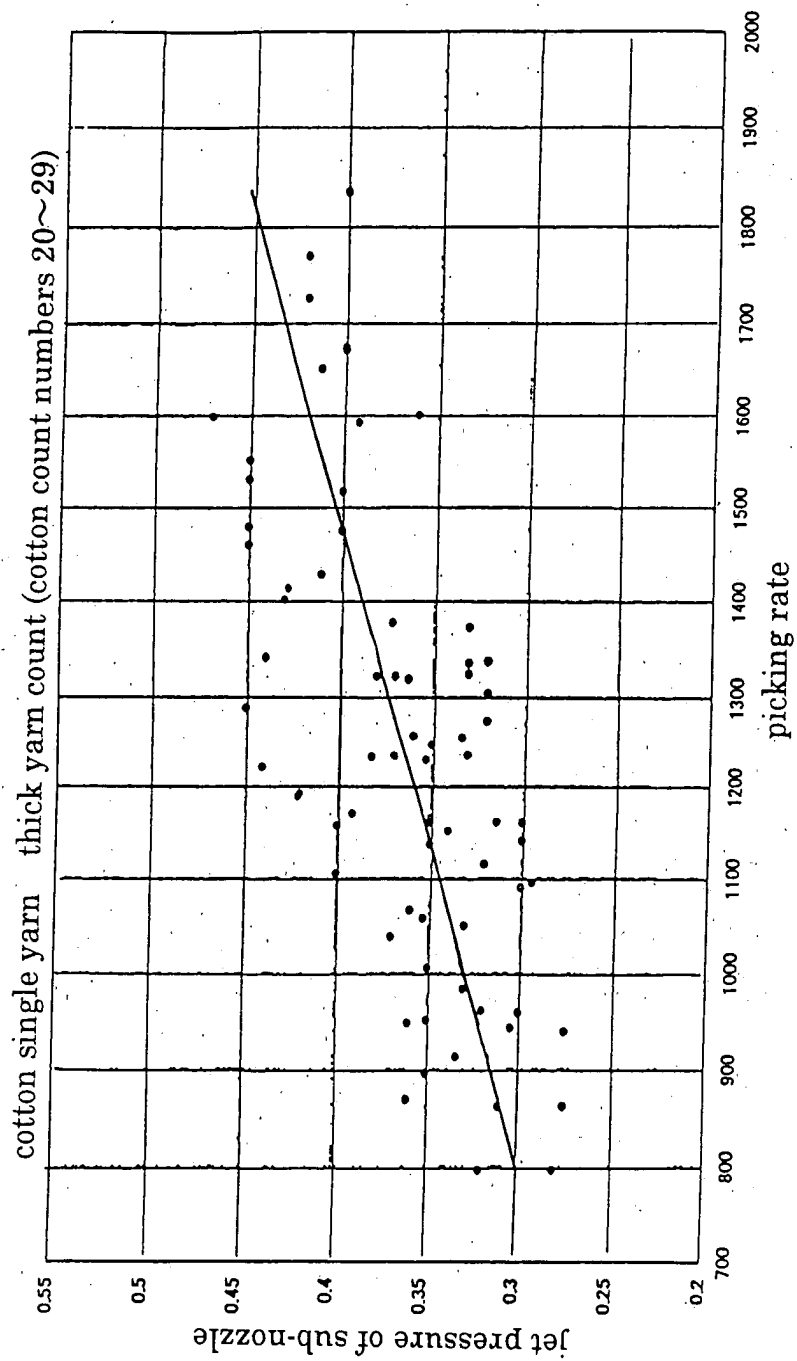


FIG. 7

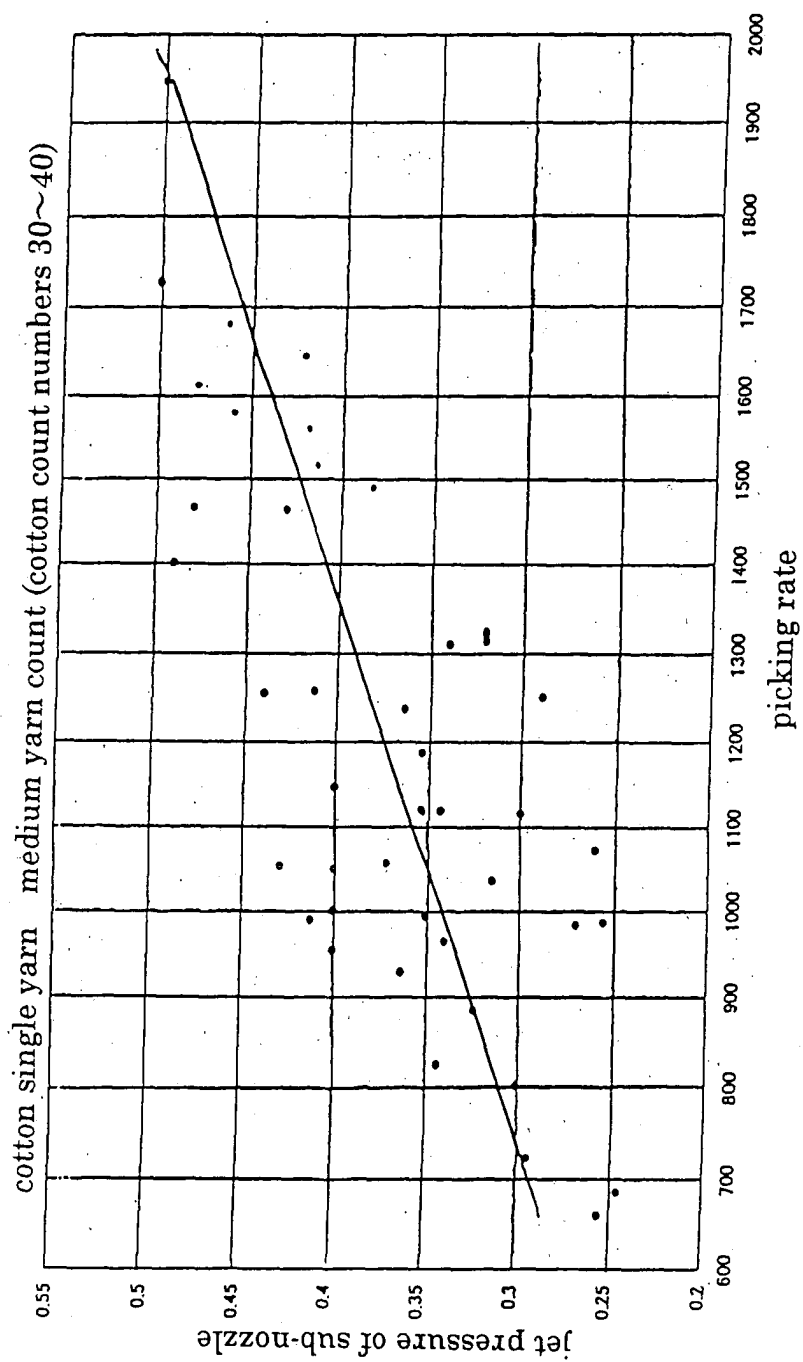


FIG. 8

the number of loom revolutions	picking rate	recommend- ed pressure value	actually set pressure	difference
800(rpm)	1360(m/min)	0.382 (MPa)	0.42 (MPa)	-0.038(MPa)
1000	1700	0.433	0.46	-0.027
1200	2040	0.484	0.53	-0.046



European Patent
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EUROPEAN SEARCH REPORT

Application Number
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Place of search MUNICH		Date of completion of the search 15 June 2004	Examiner Louter, P
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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