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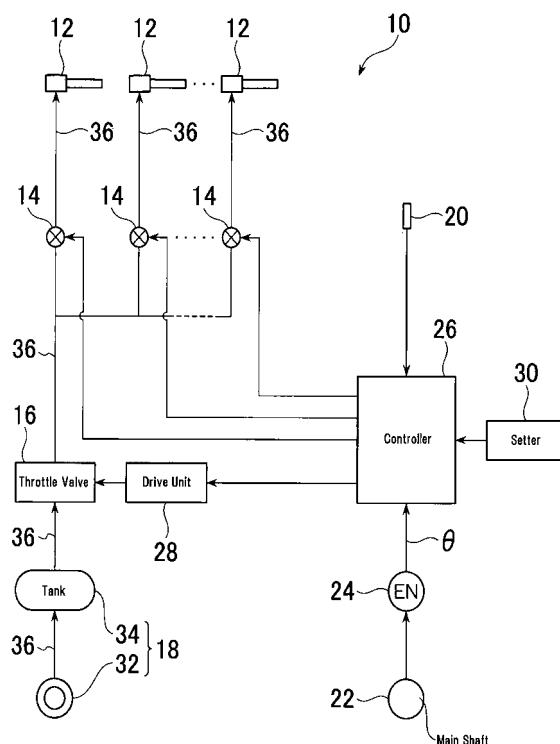
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(54) Weft insertion device

(57) A weft insertion device (10) comprises: a plurality of nozzles (12), each of which flies one of a plurality of weft yarns; a plurality of opening and closing valves (14) each of which is connected to one of the nozzles (12); a pressure adjusting valve (16) connected in common with the plural valves (14) at their fluid inlets; a pressure source (18) for supplying a compressed fluid maintained at a predetermined pressure value to the pressure adjusting valve (16); and a controller (26) for controlling opening and closing of one opening and closing valve (14) selected sequentially from the plural opening and closing valves (14) and the preset value of the pressure adjusting valve (16).

Fig. 1



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a weft insertion device in a fluid-jet multiple color weft insertion loom.

Description of Prior Art

[0002] A weft insertion device in a fluid-jet multiple color weft insert loom has a main nozzle for each weft yarn which can be inserted to selectively pick a plurality of weft yarns.

[0003] As a result, in such a weft insertion device, it is necessary to change over fluid injection pressure for weft insertion instantly for each weft insertion (i.e., after injection for the present weft insertion ended until injection for the next weft insertion starts) to a predetermined value according to a yarn kind.

[0004] One of such weft insertion devices such as mentioned above detects the air pressure by a pressure sensor provided at an inlet of a tank for storing compressed air, feeds back the detected air pressure to a controller, and thereby changes the air pressure within the tank to a set injection pressure (Patent Document 1).

Patent Document 1

[0005] Japanese Patent Appln. Public Disclosure No. 2003-3350 Official Gazette

[0006] In the foregoing conventional weft insertion device, however, since it is necessary to switch air intake and exhaust of the compressed air within the tank by using a servo valve attached to the tank, it takes time for the air pressure within the tank to become a target injection pressure, resulting in weft insertion failure due to insufficient pressure or overpressure of the injected fluid.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to enhance injection pressure followability of each nozzle and to simplify piping.

[0008] The weft insertion device according to the present invention comprises a plurality of nozzles respectively flying one of plural weft yarns, a plurality of opening and closing valves respectively connected to one of the nozzles, a pressure adjusting valve connected in common with the plural opening and closing valves at their fluid inlets, a pressure source for supplying a compressed fluid kept at a predetermined pressure value to the pressure adjusting valve, and a controller for controlling the preset value of opening and closing of one of the opening and closing valves selected sequentially from the opening and closing valves and the preset value of the pressure adjusting valve.

[0009] Incidentally, the pressure adjusting valve includes a throttle valve and a device for controlling the fluid pressure and fluid flow of an electropneumatic proportional valve (pressure and flow control). Also, the preset value can mean either one of a degree of narrowing by the throttle valve and the pressure value or the fluid flow value in the electropneumatic proportional valve. A value of adjustment rate in an adjustment range of narrowing of the throttle valve can be set for setting the degree of narrowing. The adjustment rate means an adjustment rate, for example, when the value corresponding to the broadest channel cross-sectional area in the adjustment range of narrowing of the throttle valve is set at the minimum 0 %, and the value corresponding to the narrowest channel sectional area is set at the maximum 100 %. Also, it is possible to set the value itself of the flow channel sectional area of the throttle valve for setting this degree of narrowing.

[0010] In the weft insertion device of the present invention, which uses a pressure adjusting valve for controlling the preset value in fluid, the pressure of the fluid injected from each nozzle or the fluid flow is instantly changed by each injection for weft insertion, as a result, the failure in weft insertion due to shortage or excess in pressure of the injected fluid can be prevented. Also, the pressure and flow rate of the fluid are controlled without changing the pressure within the tank, so that responsiveness to a change in the preset value in fluid, i.e., the amount of the pressure and fluid flow is fast. Further, since the pressure adjusting valve is used in common with a plurality of nozzles, the piping is simplified.

[0011] It is possible to make the controller control the preset value while all the opening and closing valves are closed.

[0012] It is possible that the weft insertion device further comprises a weft feeler for detecting each inserted weft yarn and an encoder for detecting the rotation angle of the main shaft of the loom, and that the controller obtains a difference in angle between the rotation angle of the main shaft when the weft feeler detected the weft injected from one of the nozzles and a target arrival rotation angle and controls the preset value of the pressure adjusting valve corresponding to each nozzle.

[0013] As a result of the above, the weft feeler detects that the weft arrived at a predetermined position, thereby obtaining a deviation of the rotation angle (rotation angle at real arrival) of the main shaft when the weft feeler generated a detection signal, and the preset value of the pressure adjusting valve can be changed according to the obtained deviation, thereby controlling weft insertion at each cycle (i.e., for each nozzle) at more accurate injection timing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a schematic view showing one embodiment

of the weft insertion device according to the present invention.

Fig. 2 is an explanatory view showing one embodiment showing data to be set in a setter.

Fig. 3 is an explanatory view showing one embodiment of another data to be set in the setter.

Fig. 4 is a view showing one embodiment of a flow chart for explaining a weft insert control routine.

Fig. 5 is a view showing one embodiment of a flow chart for explaining a valve opening and closing control routine.

Fig. 6 is a view showing one embodiment of a flow chart for explaining a weft arrival rotation angle control routine.

PREFERRED EMBODIMENT OF THE INVENTION

[0015] An embodiment of the weft insertion device

[0016] Referring to Fig. 1, the weft insertion device 10 is used as a device for selectively inserting a plurality of weft yarns in a fluid-jet multiple color weft insert loom using a compressed fluid such as air under pressure or pressed liquid under pressure.

[0017] In this embodiment, a throttle valve to be electrically controlled is used as its pressure adjusting valve in an air-jet loom, and the degree of narrowing of the throttle valve is arbitrarily controlled.

[0018] The weft insertion device 10 comprises: a plurality of main nozzles 12 which inject one of the plural weft yarns together with the compressed fluid; a plurality of opening and closing valves 14 respectively connected to one fluid inlet of the main nozzle 12 and to be electrically controlled; one throttle valve 16 connected in common with the fluid inlets of the plural opening and closing valves 14; a pressure source 18 for supplying the compressed fluid maintained at a fixed pressure value at the throttle valve 16; the weft feeler 20 for detecting the inserted weft; an encoder 24 for generating a rotation angle signal θ which represents the rotation angle of the main shaft 22 of the loom; a controller 26 for controlling opening and closing the opening and closing valves 14 and the degree of narrowing of the throttle valve 16; a drive unit 28 controlled by the controller 26 to drive the throttle valve 16; and a setter 30 in which various kinds of data are set. Here, the drive unit 28 is, for example, an actuator such as a motor, and electrically adjusts the degree of narrowing to control the fluid flow of the throttle valve 16 by a motor. In this case, the drive unit 26 outputs a predetermined pulse into the motor according to the degree of narrowing as set. Further, a plurality of subnozzles (not shown) are provided in a flying channel of the weft along a weaving width and convey the weft to a weft non-feeding side by injection of the compressed fluids from the subnozzles.

[0019] The pressure source 18 has, in the illustration, a compressed fluid generator 32 such as a pump, and a tank 34 for storing the compressed fluid generated in the compressed fluid generator 32.

[0020] Respective sets of each main nozzle 12 and the opening and closing valve 14 corresponding thereto, each opening and closing valve 14 and the throttle valve 16, the throttle valve 16 and the tank 34, and the tank 34 and the compressed fluid generator 32 are connected by the piping 36.

[0021] The weft feeler 20, detecting the front end of the weft, supplies a detection signal, that is, the weft feeler signal to the controller 26. The encoder 24 generates a pulse signal every time the main shaft 22 rotates at a predetermined angle (e.g., 1°), counts the pulse signals and supplies the discrete value to the controller 26 as the rotation angle signal θ .

[0022] The controller 26, confirming that the main shaft 22 rotated once on the basis of the rotation angle θ , calculates the frequency of the weft insert cycles (picks) and stores the calculated frequency in an internal memory. The controller 26 calculates the rotation angle (real arrival rotation angle) of the main shaft 22 when the weft feeler signal from the weft feeler 20 is inputted, and stores the calculated real arrival rotation angle in the internal memory.

[0023] In the setter 30, as shown in Fig. 2, the degree of narrowing of the throttle valve 16, a period of injection (injection time) of the compressed fluid from the main nozzle, and a target arrival rotation angle of the weft (the angle of the main shaft at which the weft should arrive at a predetermined position) are set at each main nozzle 12 in a form of a table. The Figure shows them with respect to three main nozzles N1, N2 and N3.

[0024] Also, in the setter 30, as shown in Fig. 3, Nos. 1, 2 and 3 for the main nozzles to be used for each weft inserting cycle (pick) are set in a form of a table together with Nos. 1, 2, 3 ... m per weft inserting cycle.

[0025] Each data set in the setter 30 is read out by the controller 26 for controlling each opening and closing valve 14 and the drive unit 28.

[0026] Each piping 36 has such a configuration as not to change the fluid flow of the compressed fluid passing the throttle valve 16 over its entire length.

[0027] Embodiment of weft insertion control

[0028] An embodiment of weft insertion control by the controller 26 is explained with reference to Fig. 4.

[0029] The controller 26 firstly counts pulse output signals from the encoder 24 to count the frequency of the weft inserting cycles and stores a discrete value in the internal memory (step 100).

[0030] In the table of Fig. 3, No. of the main nozzle corresponding to each pick (cycle) is stored as weft insertion pattern, and the controller 26 specifies (selects) No. of the main nozzle 12 to be used in a new weft inserting cycle when the loom starts an action by the table of Fig. 3 (step 101).

[0031] Then, the controller 26 reads the degree of narrowing S_n corresponding to the specified main nozzle 12 of the throttle valve 16, the injection time θ_{ns} and θ_{ne} (step 102).

[0032] As the degree of narrowing S_n about each main

nozzle 12, the values in the table in Fig. 2 are used in the initial weft inserting cycle, and in the cycles thereafter, when a correction value is obtained by the weft arrival angle control routine, the obtained correction value is used. The injection times θ_{ns} and θ_{ne} can be obtained from the table in Fig. 2.

[0033] Steps 100, 101 and 102 are carried out between the time when the opening and closing valve 14 used in the present weft inserting cycle is closed and the time when the opening and closing valve 14 to be used for a new (the next) weft inserting cycle is opened.

[0034] At the time of the new weft inserting cycle, the controller 26 outputs a narrowing command corresponding to the previously specified degree of narrowing S_n into the drive unit 28 (step 103). This makes the drive unit 28 drive the throttle valve 16 so that the degree of narrowing may become S_n .

[0035] Next, the controller 26 calculates the routine for opening and closing the valve 14 corresponding to the specified main nozzle 12 (step 104). In this step 104, the controller 26 uses the injection times θ_{ns} and θ_{ne} previously specified.

[0036] Next, the controller 26 calculates the deviation between the real arrival rotation angle of the weft and the target arrival rotation angle and carries out the weft arrival angle control routine for calculating the degree of narrowing S_n to be used for next and subsequent weft insertion about the nozzle (step 105).

[0037] After the step 105, the controller 26 ends one round of weft inserting action. The steps 100 through 105 above, however, are repeatedly carried out at each weft inserting cycle while weaving is performed.

[0038] Embodiment of the valve opening and closing control routine

[0039] An embodiment of the valve opening and closing control routine is explained with reference to Fig. 5.

[0040] The controller 26 judges firstly whether or not, upon receipt of the rotation angle θ from the encoder 24 (step 110), the rotation angle θ reached the angle θ_{ns} for opening the opening and closing valve 14 (step 111).

[0041] As a result of the judgment in the step 111, unless the angle θ_{ns} is reached, the controller 26 returns to the step 110.

[0042] As a result of the step 111, if the angle θ_{ns} is reached, the controller 26 opens the opening and closing valve 14 corresponding to the main nozzle 12 specified in the step 101 in the weft insert control routine shown in Fig. 4 (step 112).

[0043] Next, upon receipt of the rotation angle θ from the encoder 24 (step 113), the controller 26 judges whether or not the rotation angle θ reached the angle θ_{ne} for closing the opening and closing valve 14 (step 114).

[0044] As a result of the judgment in the step 114, unless the angle θ_{ne} is reached, the controller 26 returns to the step 113.

[0045] As a result of the judgment in the step 114, if the angle θ_{ne} is reached, the controller 26 closes the opening and closing valve 14 corresponding to the main

nozzle 12 specified in the step 101 in the weft insert control routine shown in Fig. 4 (step 115), and thereafter, ends the valve opening and closing control routine.

[0046] The above-mentioned valve opening and closing control routine is carried out at each weft inserting cycle.

[0047] The controller 26 may be adapted to control the amount of narrowing of the throttle valve 16 while all the opening and closing valves 14 are closed.

[0048] Further, the controller 26 may be adapted to control to correct the degree of narrowing so as to correspond to each main nozzle 12 of the throttle valve 16, based on the difference in angle between the rotation angle of the main shaft 22 at the time the weft feeler 20 detected the weft injected from one of the main nozzles 12 and the preset target arrival rotation angle (step 105).

[0049] Embodiment of the weft arrival angle control routine

[0050] The controller 26 judges at the time of weft insertion firstly whether or not the weft feeler signal is inputted from the weft feeler 20 (step 120).

[0051] As a result of the judgment in the step 120, unless the feeler signal is inputted, the controller 26 returns to the step 120.

[0052] As a result of the judgment in the step 120, when the feeler signal is inputted, the controller 26 acquires a rotation angle (real arrival rotation angle) θ_f of the main shaft 22 at the time of the input of the feeler signal (step 121).

[0053] Then, the controller 26 stores the acquired real arrival rotation angle θ_f at an area of the internal memory and accumulates it (step 122). The area storing the real arrival rotation angle θ_f is an area assigned to the used main nozzle.

[0054] Then, the controller 26 judges whether or not the number of the accumulated real arrival rotation angles θ_{nf} concerning the used main nozzle reached a predetermined value N , namely, whether or not as much as N times (for N cycles) of θ_{nf} are accumulated (step 123). For the count of N , the frequency of the weft inserting cycle in the step 100 may be used.

[0055] As a result of judgment in the step 123, unless the predetermined value N is reached, the controller 26 ends the weft arrival angle control routine.

[0056] As a result of the judgment in the step 123, if the predetermined value N is reached, the controller 26 calculates an average value of the latest N times of the read arrival rotation angle θ_{nf} (step 124).

[0057] Next, the controller 26 calculates a deviation between the calculated average value and the target arrival rotation angle θ_{nf0} of the corresponding main nozzle (step 125).

[0058] Then, the controller 26 calculates a new degree of narrowing S_n which is a degree of narrowing after correction from the degree of narrowing of the main nozzle corresponding to the above-mentioned deviation, and stores it as a renewed value S_n in the internal memory (step 126). In detail, the feeding speed of the weft is in-

creased by reducing the degree of narrowing in accordance with the deviation in case the above average value $> \theta_{nf0}$, thereby enlarging the flow channel sectional area of the throttle valve. On the contrary, in case that the above average value $< \theta_{nf0}$, the degree of narrowing is enlarged, and by making the flow channel sectional area of the throttle valve small by enlarging the degree of narrowing in correspondence to the deviation, thereby reducing the feeding speed of the weft. The value S_n of the renewed degree of narrowing is used as a preset value of the throttle valve 16 at the time of subsequent weft insertion.

[0059] Thereafter, the controller 26 ends the weft arrival angle control routine. The above-mentioned controller 26 carries out the weft arrival angle control routine every time the weft is inserted.

[0060] In the above-mentioned embodiment, the average value of the real arrival rotation angles θ_f is calculated, but the renewed value S_n of the degree of narrowing may be calculated by calculating the deviation between the real arrival rotation angle θ_f and the target arrival rotation angle θ_{nf0} at each weft inserting cycle.

[0061] Also, a plurality of the main nozzles 12 may be divided into groups, and each group may be provided with the throttle valve 16. For instance, in a multiple color weft insert loom having six main nozzles 12, the throttle valve 16 may be provided at three main nozzles 12 each.

[0062] Incidentally, in the foregoing embodiment, it is possible to control the fluid pressure or the fluid flow by using an electropneumatic proportional valve in place of the throttle valve. In this case, the controller 26, outputting the voltage value or the electric current value corresponding to the preset value, namely, the predetermined pressure value or the fluid flow value, controls the fluid pressure or the fluid flow.

Industrial availability

[0063] The present invention is not limited to the above embodiments but can be variously modified without changing the purport. In the present embodiments, the present invention is applied to an air jet loom, it can be applied to a water-jet loom.

Claims

1. A weft insertion device for selectively inserting a plurality of weft yarns in a fluid-jet loom, comprising: a plurality of nozzles each of which flies one of the weft yarns; a plurality of opening and closing valves, each of which is connected to one of the nozzles; a pressure adjusting valve connected in common with the plural opening and closing valves at their fluid inlets; a pressure source for supplying a compressed fluid maintained at a predetermined pressure value to the pressure adjusting valve; and a controller for controlling opening and closing one of the opening and

closing valves sequentially selected from the opening and closing valves and the preset value of the pressure adjusting valve.

2. A weft insertion device claimed in claim 1, wherein said controller controls the preset value of the pressure adjusting valve while all of the opening and closing valves are closed.
3. A weft insertion device claimed in claim 1, further comprising a weft feeler for detecting each inserted weft, and an encoder for detecting the rotation angle of the main shaft of said fluid-jet loom, wherein said controller selectively controls said opening and closing valves so as to inject the weft yarns from one nozzle selected sequentially from the plural nozzles, and obtains a difference in angle between the rotation angle of said main shaft when said weft feeler detected the weft injected from said nozzle corresponding to said selected opening and closing valves and the preset target arrival rotation angle, thereby controlling the preset value corresponding to each nozzle of said pressure adjusting valve.
4. A weft insertion device claimed in any one of claims 1 through 3, wherein said pressure adjusting valve is the throttle valve and the preset value means the degree of narrowing of said throttle valve.
5. A weft insertion device claimed in claim 3, wherein a deviation is calculated from said difference in angle, and the preset value corresponding to said nozzle in said opening and closing valve selected on the basis of the deviation is renewed, and the renewed preset value is used as the subsequent preset value corresponding to the nozzle.
6. A weft insertion device claimed in claim 5, wherein the deviation can be obtained from the difference in angle between the average value of the rotation angles of said main shaft in the predetermined cycles of said loom and the target arrival rotation angle.

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Fig. 1

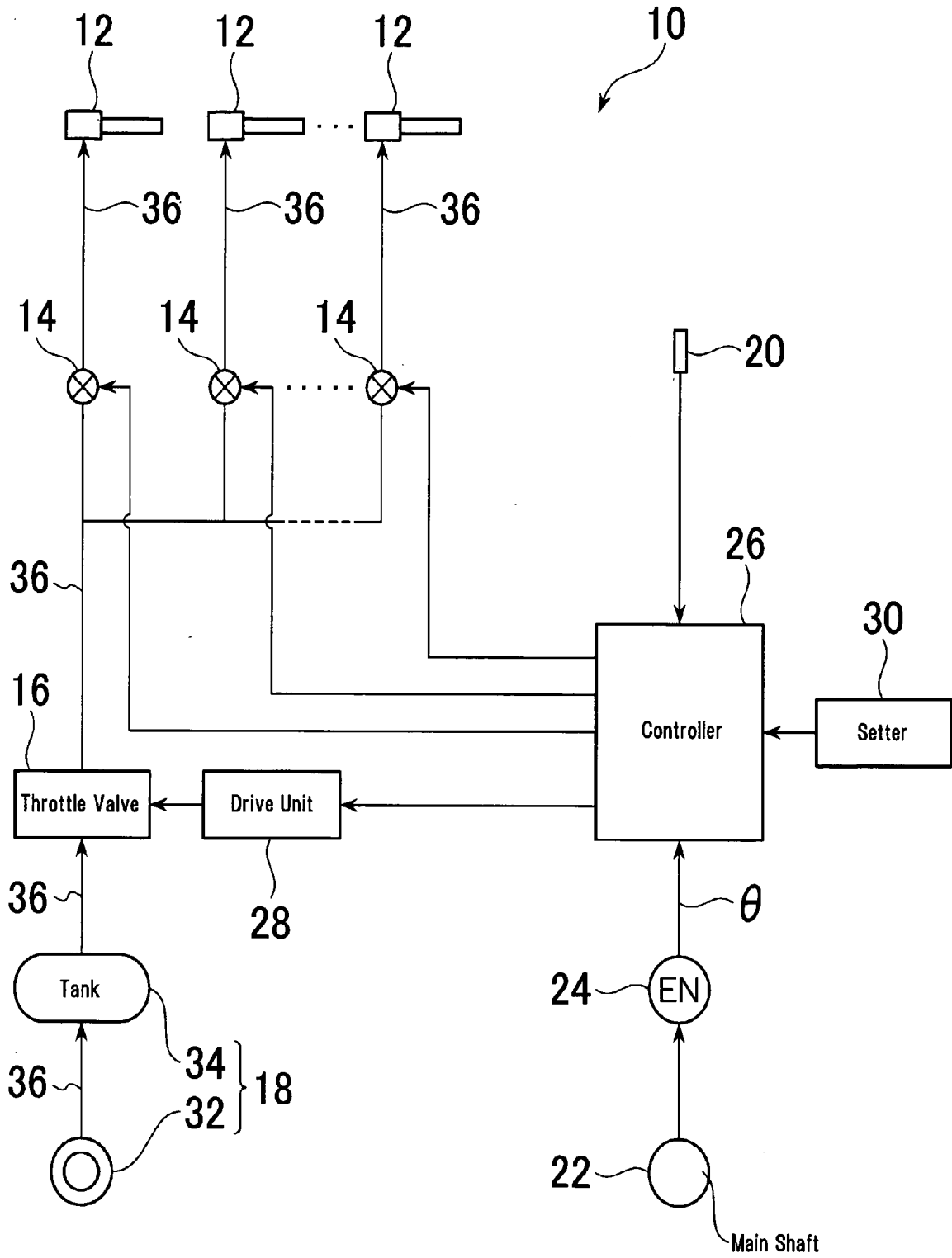


Fig. 2

Main Nozzle No.	Degree of Narrowing	Injection Period	Target Arrival Rotation Angle
N1	S1	$\theta_{1s}-\theta_{1e}$	θ_{1f0}
N2	S2	$\theta_{2s}-\theta_{2e}$	θ_{2f0}
N3	S3	$\theta_{3s}-\theta_{3e}$	θ_{3f0}

Fig. 3

Pick (cycle)	Main Nozzle No.
1	N2
2	N2
3	N1
⋮	⋮
m	N3

Fig. 4

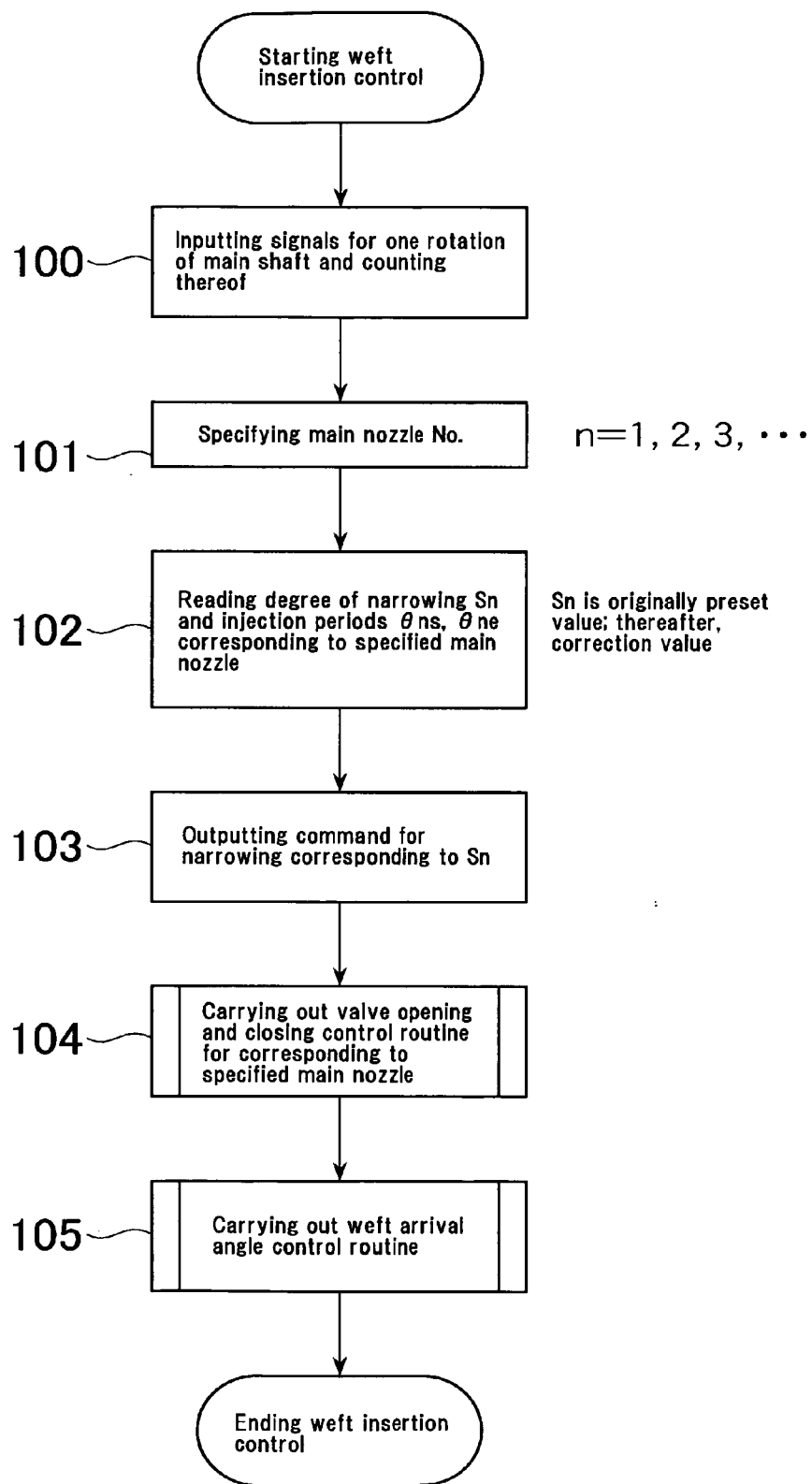


Fig. 5

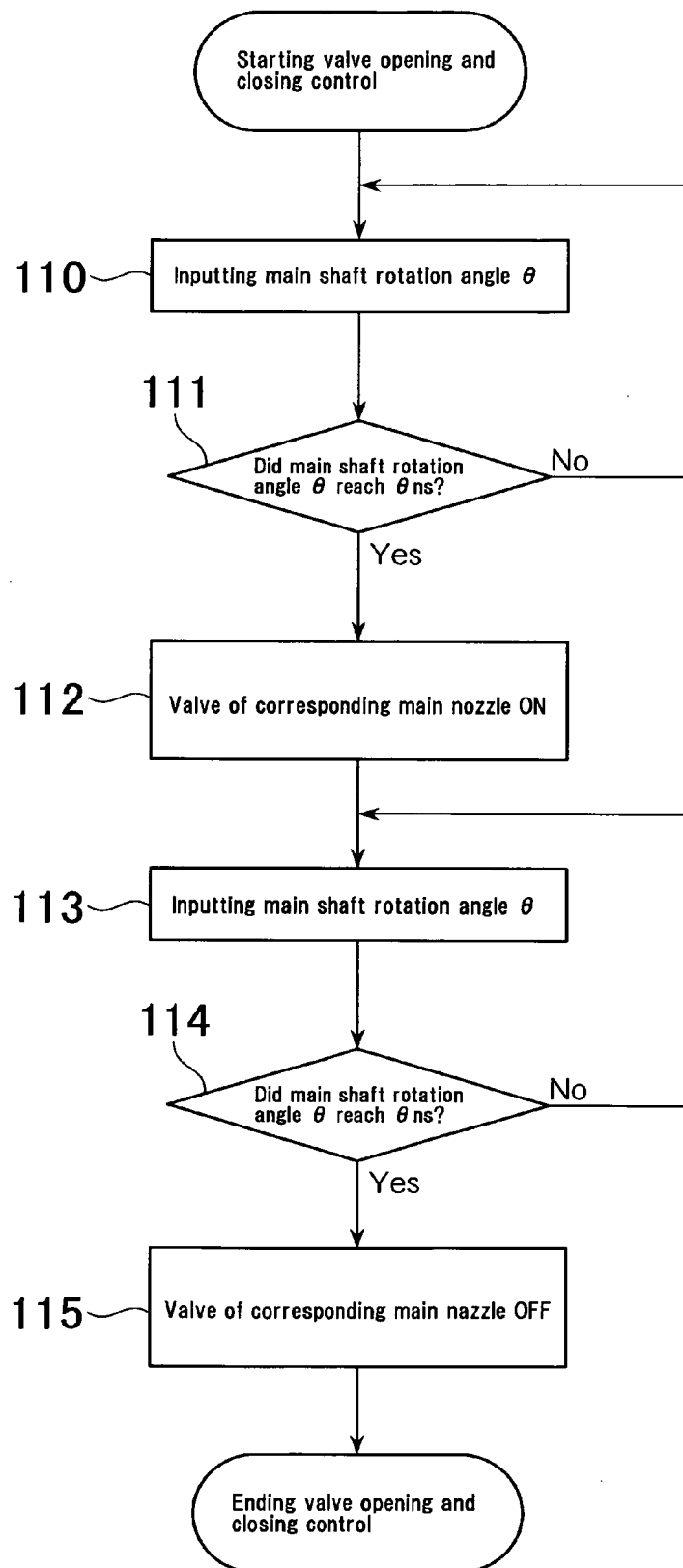
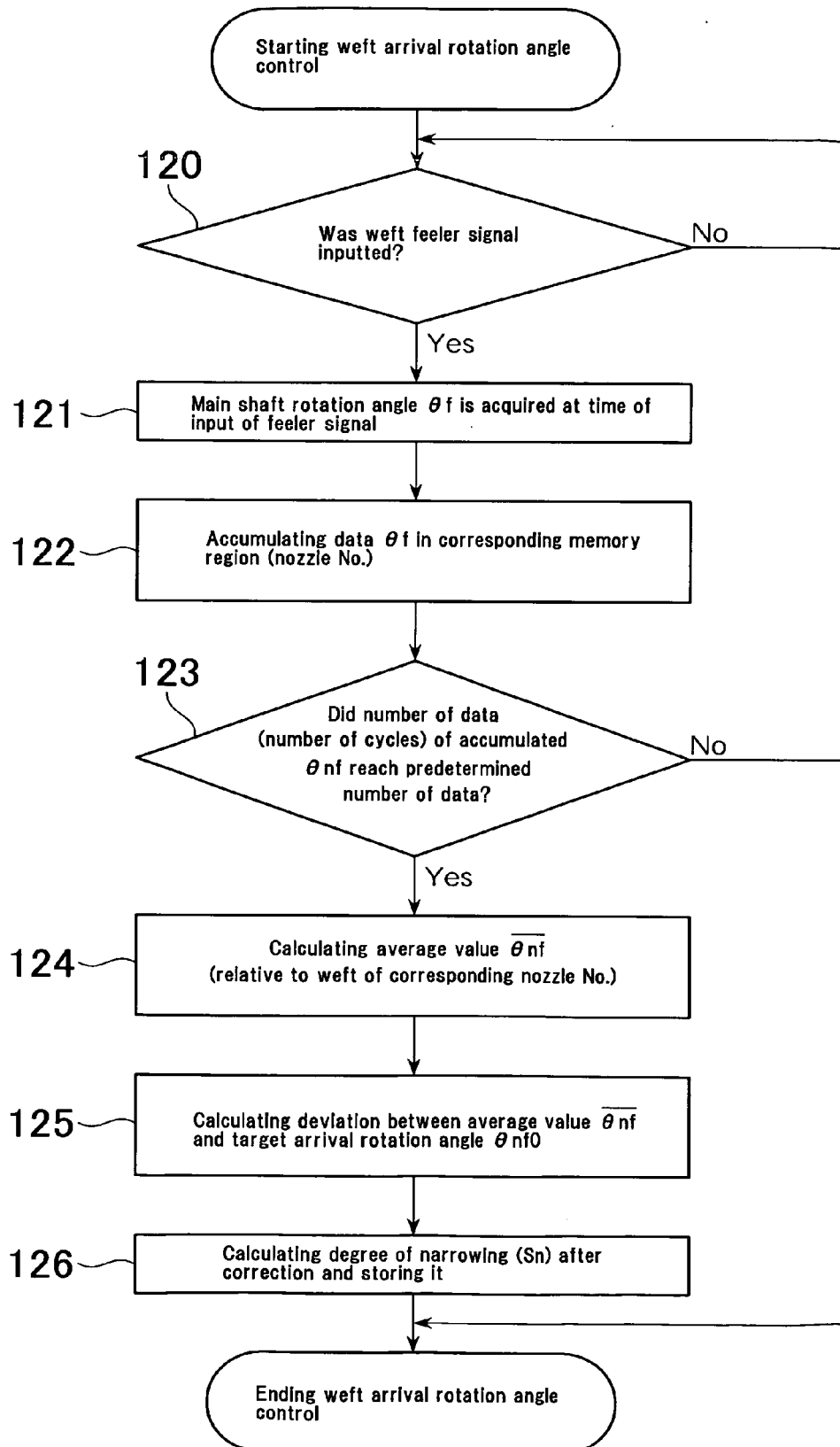


Fig. 6



REFERENCES CITED IN THE DESCRIPTION

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