(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 500 498 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **92810108.8**

(51) Int. Cl.^{5} : **D03D 51/34**

(22) Date of filing : **17.02.92**

(30) Priority : **20.02.91 JP 26263/91**

(43) Date of publication of application :
26.08.92 Bulletin 92/35

(84) Designated Contracting States :
BE DE FR IT

(71) Applicant : **Kabushiki Kaisha Toyoda Jidoshokki Seisakusho**
1, Toyoda-cho 2-chome, Kariya-shi
Aichi-ken 448 (JP)

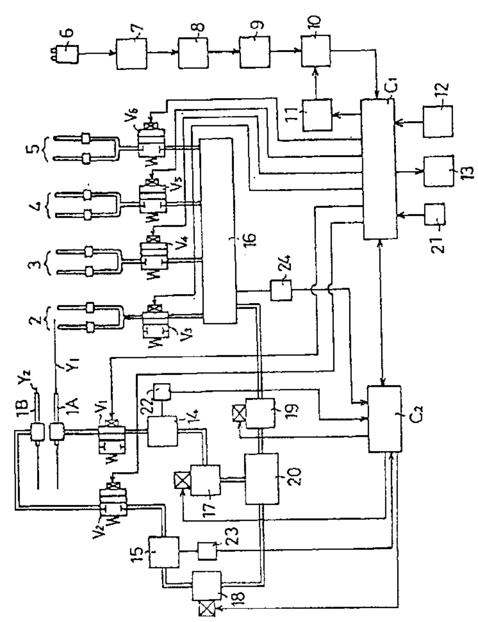
(72) Inventor : **Ohta, Kazuharu c/o Kabushiki Kaisha Toyoda**
Jidoshokki Seisakusho, 1, Toyoda-cho 2-chome
Kariya-shi, Aichi-ken (JP)

(74) Representative : **Hammer, Bruno, Dr.**
c/o Gebrüder Sulzer AG, KSR/Patente/0007
CH-8401 Winterthur (CH)

(54) Apparatus for displaying weft detecting result in a jet loom.

(57) The apparatus provides a facilitated setting of reference number of pulse signals for comparison with the number of pulse signals converted from electrical signals generated by a photoelectrically-operated weft detector. Electrical signals generated by the photoelectrically operated weft detector (6) are converted into pulse signals by the comparator and converter circuit (9), and the AND circuit (10) finds a logical product of the above pulse signals and a time signal provided by the weft detection time signal generator circuit (11). The number of high-level signals generated by the AND circuit (10) represents the number of pulse signals generated from weft detection during a predetermined period of time in one cycle of weft insertion, and these pulse signals (S_4) are counted by the computer control (C_1) for each weft pick.

Fig. 1



EP 0 500 498 A1

The present invention relates to an apparatus in a jet loom for detecting a weft and displaying the result of said weft detection.

A weft detector of photoelectric type is used for detectong the presence of a weft inserted by air jet in an jet loom. This type of weft detector is disclosed by Publication of the unexamined Japanese Patent Application No. 61-239059 (1986). This weft detector is adapted to emit light against a weft and receive light reflected therefrom thereby to sense the variation in the amount of the reflected light for transmitting a pulse signal when the magnitude of an electrical signal produced according to the variation is greater than a predetermined value. Such conversion of a electrical signal into a pulse signal is made for the purpose of distinguishing a weft from foreign matters such as fly. The number of pulse signals generated when a weft is detected is so different from the number of pulse signals produced when fly is detected that the comparison of the number of pulse signal generated from the detection by the weft detector with a predetermined number can make it possible to distinguish a weft from fly. However, the number of pulse signals to be thus produced varies noticeably depending on the kind, count number, color, etc. of a weft to be detected, as well as on the arrival time at which the leading end of an inserted weft reaches a predetermined terminating extremity position in the weft insertion passage across the loom. Therefore, setup adjustment of a reference number of pulse signals to be compared with variable numbers of pulse signals generated from weft detection is a very complicated and time-consuming procedure.

If the reference number of pulse signals is set too large, a weft tends to fail to be detected properly in spite that there actually exists a weft. If the reference signal number is set to small, on the other hand, the tendency of a weit being detected in spite that there actually exists no such weft is increased. Such errors in weft detection will invite downtime in production operation due to frequent unnecessary stops of the loom if the reference pulse signal number is too large, or idle weaving operation, i.e. the loom being in weaving motion without insertion of a weft if the reference number is too small.

Therefore, an object of the present invention is to provide an apparatus in a jet loom which can permit easy and optimum setup adjustment of reference pulse signal number for comparison with the number of pulse signals generated from weft detection.

To achieve the above object, the present invention provides an apparatus for displaying weft detecting result in a jet loom comprising photoelectrically-operated means for detecting a weft, said weft detecting means being adapted to generate electrical signals in accordance with a change in the amount of light received by the detecting means, comparator and converter means for comparing the electrical signals generated by the photoelectrical weft detecting means with a thréshold valve and then converting the electrical signals into pulse signals according to the comparison, counting means for counting the number of pulse signals generated by the comparator and converter means during a predetermined period of time in one complete weft insertion cycle for each weft pick, and display means fordisplaying a value indicating the number of pulse signals counted by the counting means.

Pulse signals generated by the comparator and converter means are counted for each weft pick, or counted alternatively as an average number for one pick by counting such pulse signals of a plurality of weft picks. The number of pulse signals thus counted is shown on the display means. The pulse signal number can be shown only while the loom is at a stop or constantly, as required. The number on display can be used as a reference aid in setting a reference pulse signal number for comparison with the number of pulse signals produced from weft detection.

The following will describe an embodiment of the displaying apparatus as applied to a jet loom for handling two different colors of wefts while making reference to the accompanying drawings including FIGS. 1 to 6 which show the following:

FIG. 1 is a schematic diagram showing in combination a weft inserting apparatus and a weft detecting and displaying circuit;

FIG. 2 shows the input mode screen on the display device;

FIG. 3 shows the detecting mode screen on the display device

FIG. 4 is a graph showing the condition of weft detection;

FIG. 5 is first part of the flow chart showing the weft detection result displaying program; and

FIG. 6 is second part of the flow chart showing the weft detection result displaying program.

Each of wefts Y_1, Y_2 flown from main weft inserting nozzles 1A, 1B, respectively, by air jets injected therefrom is assisted in flying through a warp shed by relayed air jets issued from a plurality of auxiliary nozzles 2, 3, 4, 5. If the weft insertion is done properly, the leading end of each inserted weft Y_1, Y_2 is detected by a weft detector 6 of photoelectric reflection type which is disposed at a predetermined extremity position for weft detection in the weft travelling passage.

The weft detector 6 emits light against the leading end of the inserted weft moving therepast and receives light reflected therefrom for generating electrical signals in accordance with the amount of light received. The electrical signals are transmitted to a comparator and converter circuit 9 through an amplifier circuit 7 and a filter circuit 8. The curved line S_1 shown in FIG. 4 represents input electrical signal to the comparator and converter circuit 9. The comparator and converter circuit 9 compares the input signal S_1 with a threshold value "d" indicated by straight line D in FIG. 4 and converts those portions of the signals S_1 which exceed the threshold value "d" into pulse signals S_2 shown in FIG. 4.

The comparator and converter circuit 9 is connected to an AND circuit 10 which finds a logical product of the pulse signals S_2 inputted thereto by the comparator and converter circuit 10 and a weft detection time signal S_3 provided by a weft detection time signal generator circuit 11 connected at its output to the AND circuit 10. The signals S_4 shown in FIG. 4 represent pulse signals generated by the AND circuit 10.

The pulse signals S_4 from the AND circuit 10 are transmitted to a computer control C_1, which in turn makes judgment whether or not a weft Y_1 (wherein i=1, 2) is detectably present by comparing the number $N_i p$ of pulse signals S_4 (wherein i=1, 2) for each of the two different wefts Y; with a predetermined value (or an integer) according to a predetermined two-color weft insertion pattern and selects either continuing or interrupting the weaving operation of the loom.

The computer congrol C_1 has connected thereto an imput device 12 for inputting reference values Z_i (wherein i: 1, 2) and a display device 13 selectably displaying input mode screen G_2 shown in FIG. 2 and detection mode screen G_2 shown in FIG. 3 depending on the position of a mode selector switch (not shown) provided on the display device 12. The input mode screen G_1 is selected in inputting the reference values Z_1, while the detection mode screen G_2 is used to display the number of pulse signals $N_i p$ transmitted from the AND circuit 10 to the computer control C_1.

Injection of air from the main weft inserting nozzles 1A, 1B is controlled by a solenoid-operated valves V_1, V_2,while injection of air from the auxiliary weft inserting nozzles 2-5 is controlled by similar solenoid-operated valves V_3, V_4, V_5, V_6. To be more specific, air injection from each nozzle takes place when the solenoid of its associated valve is being energized, thereby opening the valve, and the air injection is stopped when the same solenoid is deenergized, thereby closing the valve. The valves V_1, V_2 are connected to air tanks 14, 15 for holding therein air under pressure, respectively, and the valves V_3-V_6 are connected to a common air tank 16. These air tanks 14, 15, 16, are in turn connected to a main air tank 20 for holding therein source air under pressure via electricallyoperated air pressure control valves 17, 18, 19, respectively.

The solenoid-operated valves V_1-V_6 are actuated to open or close in response to a command from the control C▪ which provides such command in response to signals transmitted from a rotary encoder 21 monitoring the current angle of rotation of the weaving loom.

There are provided pressure detectors 22, 23, 24 which are connected at their input to the air tanks 14, 15, 16, respectively, for detecting the air pressures in these tanks, and at their output to a computer control C_2 for transmitting thereto information of detected air pressures. The control C_2 thus provides a feedback control of the pressure control valves 17, 18, 19 with the aid of the information of the current air pressures detected by the pressure detectors 22, 23, 24.

Referring to FIG. 2 showing an input mode screen G_1, COLOR1 on the screen represents the weft Y_1 released from the main inserting nozzle 1A and COLOR2 the weft Y_2 released from the other nozzle 1B, respectively. On the same screen G_1, Z_1 indicates a reference number of pulse signals set for the weft Y_1 and Z_2 a similar reference number set for the weft Y_2. These reference pulse signal numbers Z_1, Z_2 can be set by inputting them from the input device 12 with the screen shown in its input mode selected by the above selector switch.

FIGS. 5 and 6 provide a flow chart showing the weft detection display program according to which the computer control C_1 performs its function of displaying the pulse signals generated from weft detection.

The computer control C_1 counts the number high-level signals generated by the AND circuit 10, i.e. the number $N_i p$ of the pulse signals S_4. When the number "p" of weft picks for each of the different wefts Y_i reaches a predetermined number "M", the control C_1 calculates to find an average value $\langle N_i p \rangle$, or the average number of pulse signals counted for one pick, from the pulse signals countd during "M" times of weft picks. This average value $\langle N_i p \rangle$ can be expressed by the equation (1) shown below.

$$\langle N_i P \rangle = [\sum_{p=1}^{M} N_i P / M]$$

The control C_1 provides this calculated average valve $\langle N_i p \rangle$ to the display device 13. If the display device 13 is then set for its detection mode screen G_2 as shown in FIG. 3 with the selector switch so placed, the display device 13 shows on the screen G_2 this average value $\langle N_i p \rangle$. N_1 on the detect mode screen G_2 represents the average number of counted pulse signals for the weft Y_1 and N_2 the average number of counted pulse signals for the weft Y_2.

If the average value $\langle N_i p \rangle$ fails to reach the reference pulse signal number Z_i, the loom operation is caused to stop. Even after such a stop of the loom, the control C_1 keeps $\langle N_i p \rangle$ to be displayed continuously on the display device 13. Thus, a loom operator can change the reference number Z_i while having reference to the value $\langle N_i p \rangle$ of actually counted pulse signals then displayed on the detection mode screen G_2. This change is made in the input mode with the mode selector switch placed in its input mode position to make the input mode screen G_1 to be displayed.

The average value $<N_i^P>$ on the detection mode screen G_2 represents the condition of pulse signal detection just before the loom is stopped. Therefore, comparison between this $<N_i^P>$ on the display value of reference number Z_i permits the loom operator to judge whether or not the setting of the latter reference number Z_i is appropriate, thus allowing the operator to make proper setting of a new reference pulse signal number on the basis of the actual number of pulse signals generated during the loom operation. Setting of the reference pulse signal number Z_1 through such comparison reflects a change in the kind, count number, color of weft, as well as in the arrival time of the weft leading end at the position defined by the weft detector 6. Thus, setting of an optimum reference pulse signal number Z_i for error-free weft detection can be made easily.

When the loom operation is resumed, the computer control C_1 displays the average value $<N_i^P>$ by counting the pulse signals generated during "M" times of weft picks in the same manner as described earlier.

Changing of the reference pulse signal number Z_i for the setup adjustment can be done with the input mode screen G_1 selected on the display device 13 even while the loom is in weaving operation. In this setup adjustment, the average value $<N_i^P>$ then displayed can be used as data for reference in changing the Z_i setting. Such setup adjustment with the loom in operation is usually performed during the phase of trial weaving operation.

It is to be noted that the present invention is not limited to the above-described embodiment, but practiced in other ways. For example, it may be so arranged that an alarm is energized for warning if the average value $<N_i^P>$ of counted pulse signal number is decreased gradually. A probable couse of such a decrease in the average value $<N_i^P>$ includes a decrease in the working performance of the weft detector 6. Thus, warning obtainable from the counted pulse signal can help the operator to acknowledge such a trouble with the weft detector 6.

Further modified embodiment is contemplatable wherein additional information of maximum and minimum values of counted pulse signal number, as well as the average value, are shown on the display device so that setting of the reference pulse signal number is performed while making reference to such additional information.

As it would be now apparent from the foregoing description, the invention can offer a useful advantage in that setting of an optimum number of pulse signals used for weft detection can be accomplished on the basis of the condition of weft detection during actual weaving operation because the number of pulse signals generated during the weaving operation is displayed and the setting can be made while having reference to the displayed information.

The apparatus provides a facilitated setting of reference number of pulse signals for comparison with the number of pulse signals converted from electrical signals generated by a photoelectrically-operated weft detector. Electrical signals generated by the photoelectrically operated weft detector 6 are converted into pulse signals by the comparator and converter circuit 9, and the AND circuit 10 finds a logical product of the above pulse signals and a time signal provided by the weft detection time signal generator circuit 11. The number of high-level signals generated by the AND circuit 10 represents the number of pulse signals generated from weft detection during a predetermined period of time in one cycle of weft insertion, and these pulse signals S_4 are counted by the computer control C_1 for each weft pick.

DESIGNATION OF REFERENCE NUMERALS

6 ... Photoelectrically-operated weft detector; 9 ... Comparator and converter circuit; 10 ... AND circuit comprising part of the counting means; 13 ... Display device; C_1 ... Computer control comprising part of the counting means.

Claims

1. Apparatus for displaying weft detecting result in a jet loom comprising:

photoelectrically-operated means (6) for detecting a weft (Y_1), said weft detecting means (6) being adapted to generate electrical signals (S_1) in accordance with a change in the amount of light received by said detecting means;

comparator and converter means (9, 10, 11) for comparing the electrical signals generated by said photoelectrical weft detecting means (6) with a threshold valve and then converting the electrical signals into pulse signals according to the comparison;

counting means for counting the number of pulse signals generated by said comparator and converter means during a predetermined period of time in one complete weft insertion cycle for each weft pick; and

display means for displaying a value indicating the number of pulse signals counted by said counting means.

2. Apparatus for displaying weft detecting result in a jet loom comprising:

photoelectrically-operated means (6) for detecting a weft (Y_1), said weft detecting means (6) being adapted to generate electrical signals (S_1) in accordance with a change in the amount of light received by said detecting means;

comparator and converter means (9, 10, 11) for comparing the electrical signals generated by said photoelectrical weft detecting means (6) with a threshold valve and then converting the electrical signals into pulse signals according to the comparison;

counting means for counting the number of pulse signals generated by said comparator and converter means during a predetermined period of time in one complete weft insertion cycle for each weft pick.

3. Apparatus as claimed in claim 2, further comprising display means (G_1) for displaying a value (Z_1) indicating the number of pulse signals counted by said counting means (10).

4. Apparatus as claimed in claim 1, 2 or 3, further comprising an input device (12) for setting minimum and maximum number of said pulse signals (S_4) for a particular type of weft yarn (Y).

5. Apparatus as claimed in of claim 4, further comprising means for detecting changes of the number of pulse signals (S_4).

6. Apparatus as claimed in claim 5, further comprising alarm means that ar actuated when the changes of the number of pulse signals (S_4) reaches a preset value.

7. Jet loom with an apparatus for displaying weft detecting results as claimed in any of claims 1 to 6.

Fig. 1

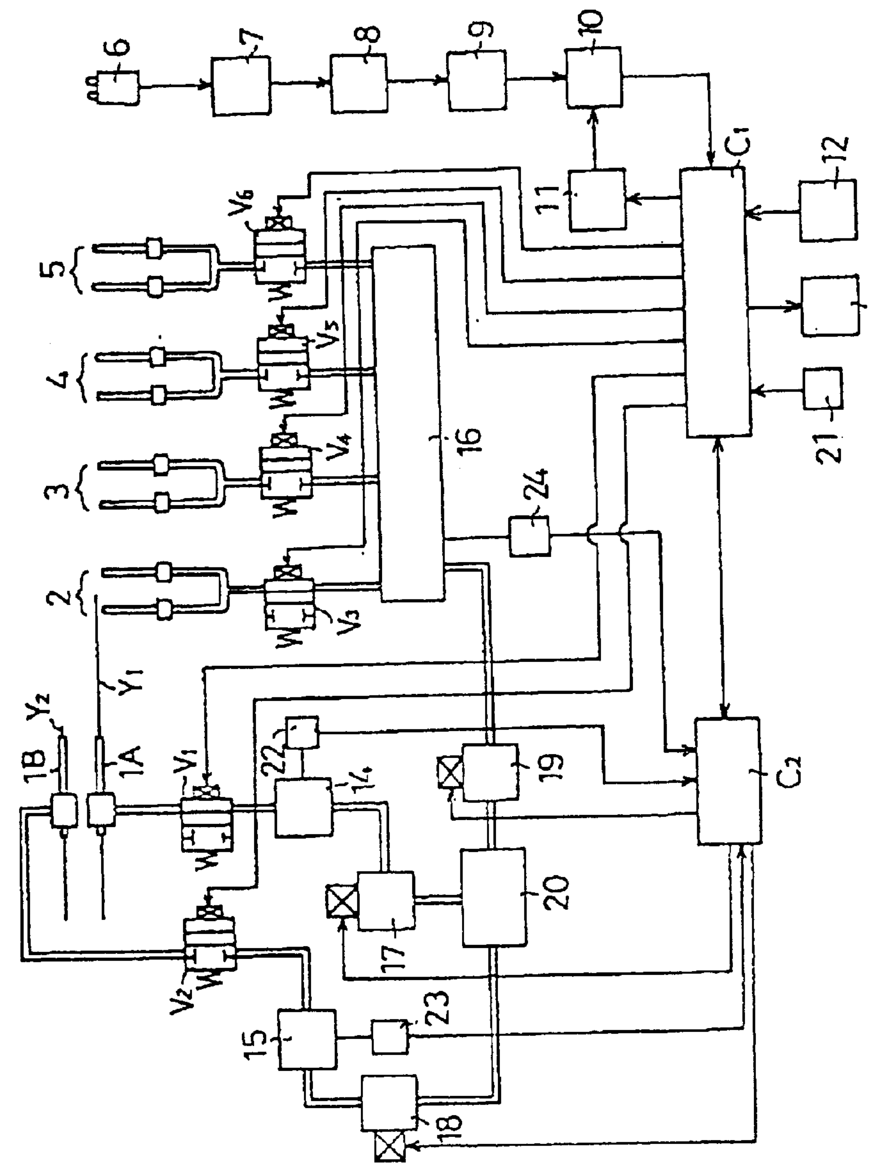

1A
1B
Y1
Y2
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
C1
C2
V1
V2
V3
V4
V5
V6
W

Fig. 2

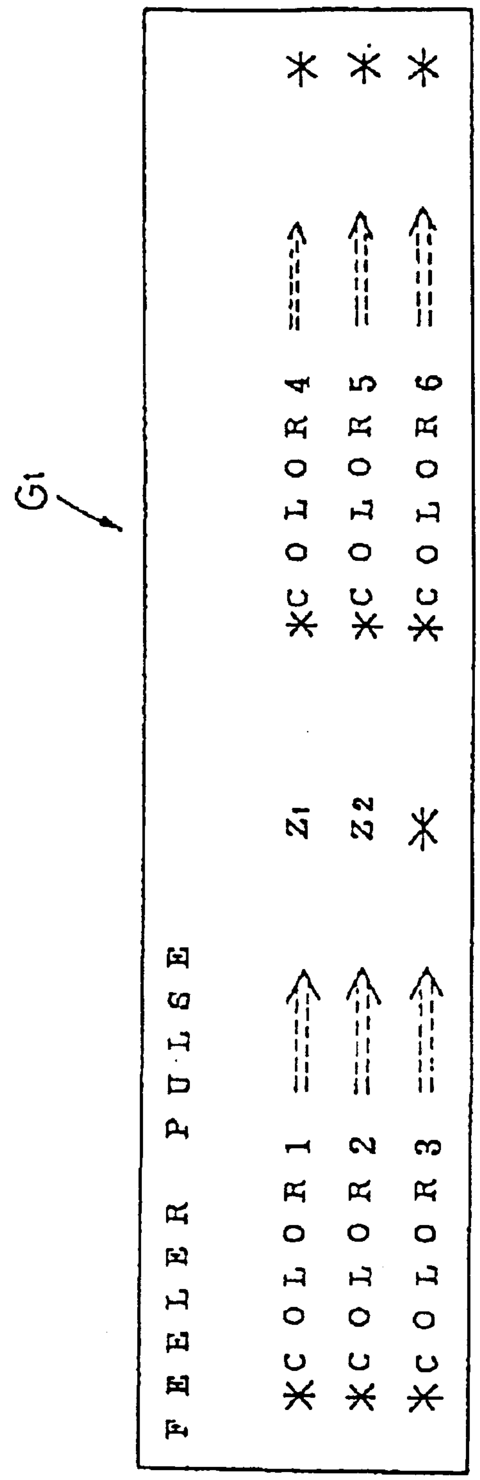

G1
FEELER PULSE
*COLOR1 ⇒ Z1 *COLOR4 ⇒ *
*COLOR2 ⇒ Z2 *COLOR5 ⇒ *
*COLOR3 ⇒ * *COLOR6 ⇒ *

Fig. 3

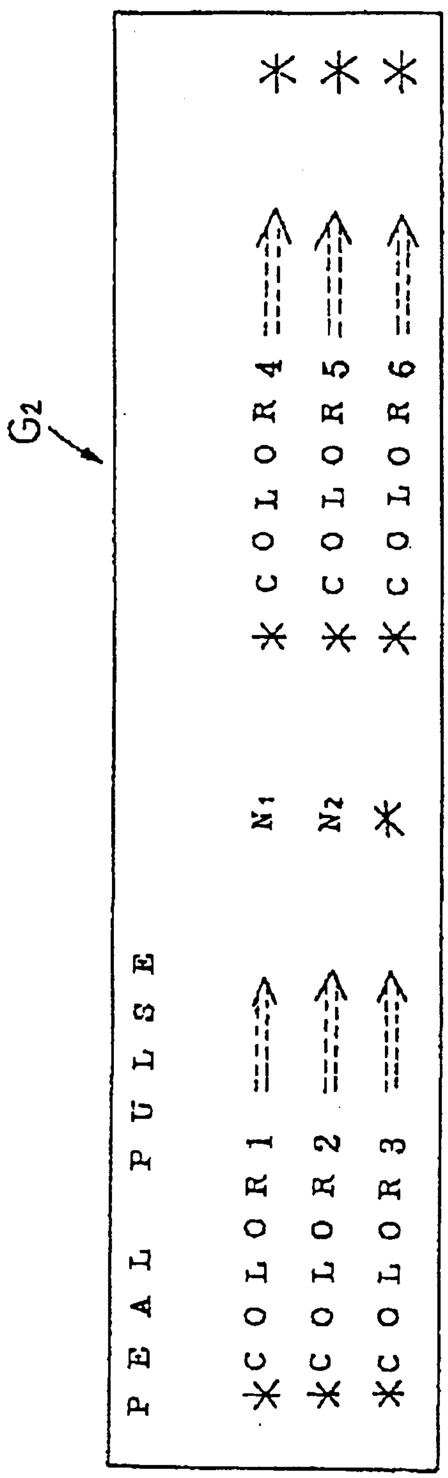

G2
PEAL PULSE
*COLOR1 ---> N1 *COLOR4 ---> *
*COLOR2 ---> N2 *COLOR5 ---> *
*COLOR3 ---> * *COLOR6 ---> *

Fig. 4

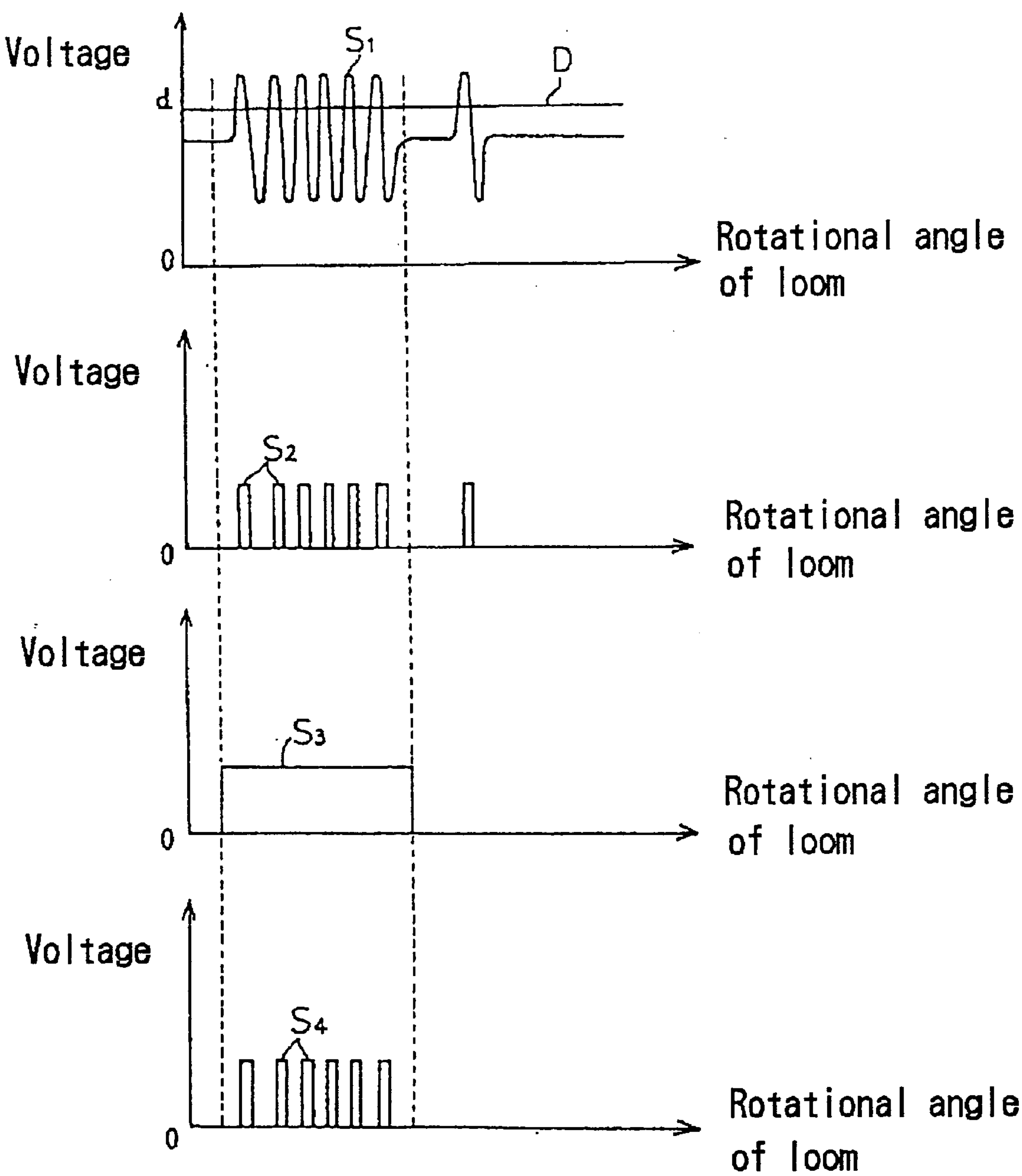

Voltage
S1
D
d
0
Rotational angle of loom
Voltage
S2
0
Rotational angle of loom
Voltage
S3
0
Rotational angle of loom
Voltage
S4
0
Rotational angle of loom

Fig. 5

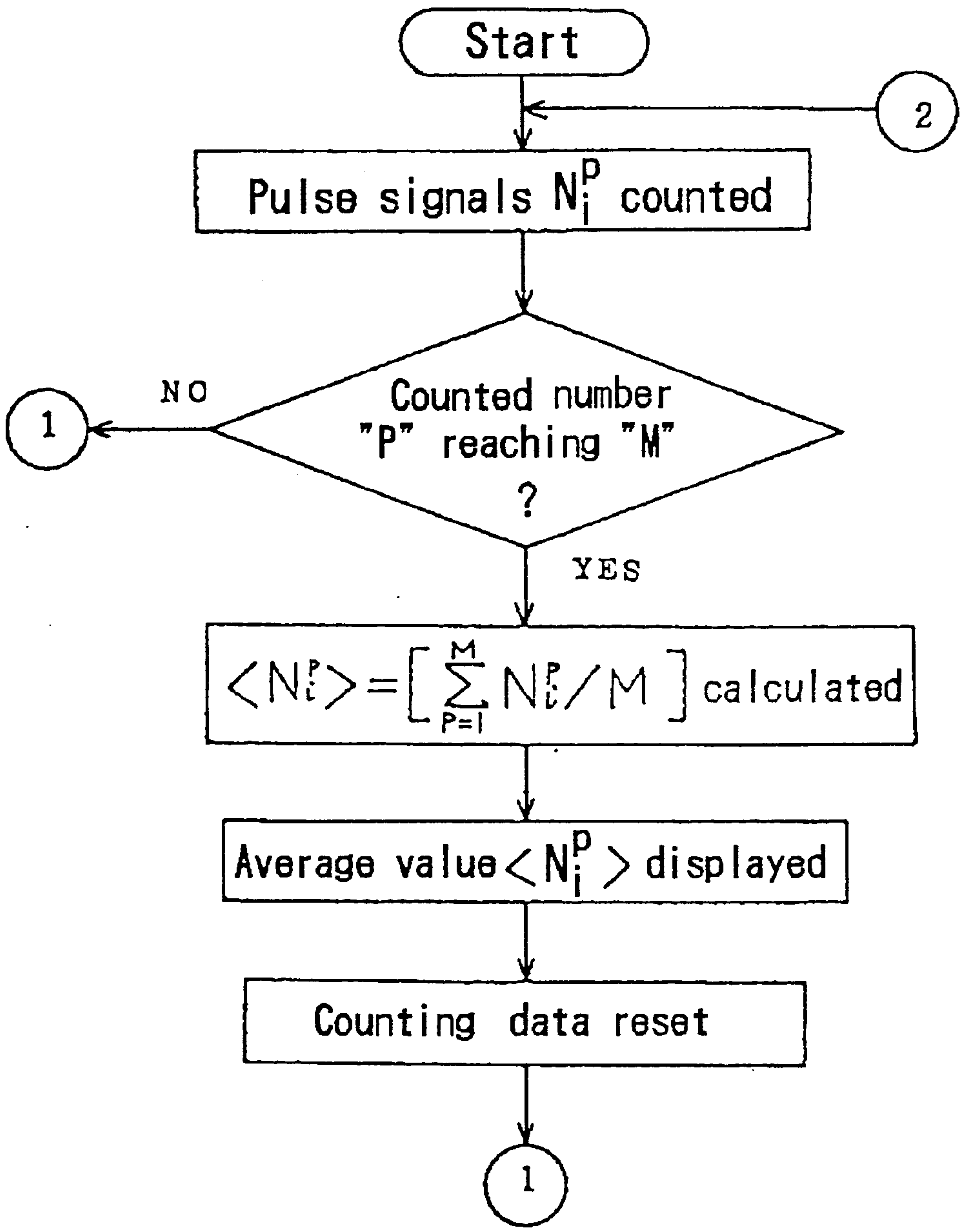
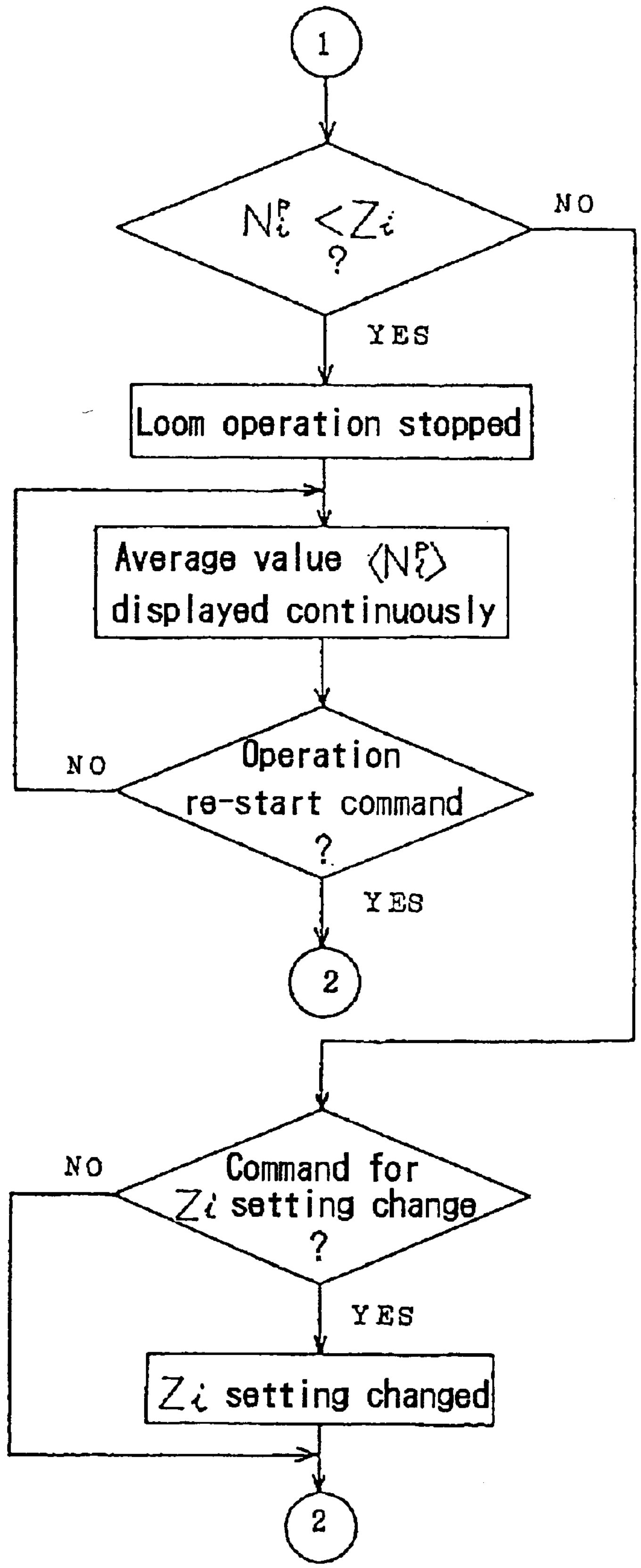

Start
2
Pulse signals N_i^p counted
NO
1
Counted number "P" reaching "M" ?
YES
$\langle N_i^p \rangle = \left[\sum_{P=1}^{M} N_i^p / M \right]$ calculated
Average value $\langle N_i^p \rangle$ displayed
Counting data reset
1

Fig. 6


1
$N_i^p < Z_i$?
NO
YES
Loom operation stopped
Average value $\langle N_i^p \rangle$ displayed continuously
Operation re-start command ?
NO
YES
2
Command for Z_i setting change ?
NO
YES
Z_i setting changed
2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 81 0108

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	FR-A-2 304 706 (SULZER) * the whole document * ---	1,2,4-7	D03D51/34
A	EP-A-0 204 093 (KABUSHIKI KAISHA TOYODA JIDOSHOKKI SEISAKUSHO) * column 18, line 16 - column 23, line 6; figures 20-28 * -----	1,2,7	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 MAY 1992	BOUTELEGIER C.H.H.

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

EPO FORM 1503 03.82 (P0401)