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(54) Weft insertion control apparatus in a jet loom.

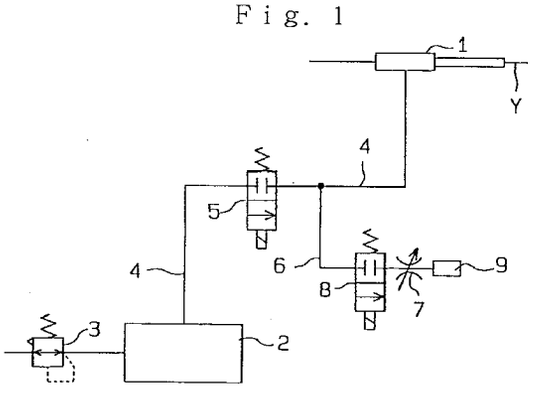
(57) OBJECT

To provide a weft insertion control apparatus in a jet loom which permits successful insertion of weak or hard twist weft.

STRUCTURE

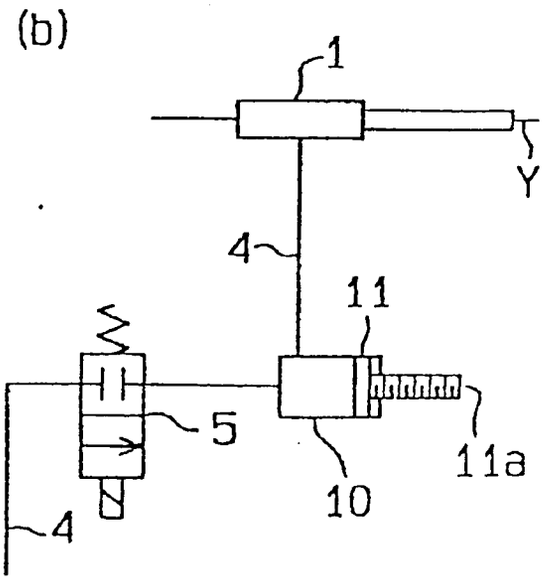
Pressure of air in the air supply tank 1 is adjusted by reducing valve 3. The main weft inserting nozzle 1 is connected to the air supply tank 1 through air supply conduit 4. There is provided a solenoid-operated air supply control valve 5 in the conduit 4. The air supply conduit 4 between the nozzle 1 and the valve 5 has an air exhaust conduit 6 branching off therefrom and having therein a flow control valve 7. There is provided a solenoid-operated air exhaust control valve 8 between the flow control valve 9 and the connection between the conduits 4, 6.

Fig. 1



EP 0 587 535 A1

Fig. 4



DETAILED DESCRIPTION OF THE INVENTION

INDUSTRIAL FIELD OF UTILIZATION

The present invention relates to a weft insertion control apparatus in a jet loom operable to insert a weft by air jet issued in a weft inserting nozzle of the loom.

PRIOR ART

Weft insertion in a jet loom is influenced by characteristics of air injection pressure change of a main weft inserting nozzle, in particular, of initial pressure rise of the air injection. If the pressure rise time is short, rapid weft insertion can be achieved and air consumption saved. If air jet with a rapid pressure rise is used for inserting a weak weft, however, its leading end may be broken during insertion. Furthermore, a weft of hard twist filament yarn, if inserted by such air jet, may be untwisted at its leading end and caught by a warp sheet.

Publication of Unexamined Japanese Patent Application 56-15442 (1981) discloses an apparatus which comprises a low pressure air supply system having a reducing valve and supplying air under a low pressure to main weft inserting nozzle during an early period of air injection by the weft inserting nozzle, and a high pressure air supply system supplying air under a high pressure to the nozzle after the above early period of the air injection. By so changing the air pressure to the nozzle, low pressure air can be used during the initial period of air injection.

Publication of Unexamined Japanese Utility Model Application 59-193882 (1984) proposes an arrangement of an adjustable throttle valve disposed in an air exhaust line which is connected to air supply line at a position between main weft inserting nozzle and an air supply control valve disposed in the air supply line. Provision of such air exhaust throttle valve can moderate the pressure rise of air injection by the weft inserting nozzle. The pressure rise can be changed by adjusting the throttle valve in the exhaust line.

Publication of Unexamined Japanese Patent Application 61-225348 (1986) proposes the use of an adjustable throttle valve which is disposed between an air supply control valve for controlling air supply to main weft inserting nozzle and an air tank holding therein air under pressure. In this prior art apparatus, the pressure rise of air injection by the nozzle can be changed by adjusting the throttle valve.

PROBLEMS THAT THE INVENTION IS TO SOLVE

In to the apparatus of Publication 56-15442, pressure rise takes place in a stepped manner and the pressure rise when high pressure air is supplied to the nozzle after the early period of air injection is so rapid that successful insertion of a weak or hard twist weft cannot be accomplished with safety.

Prior art according to Publication 59-193882 is disadvantageous in that part of air under pressure leaks constantly through the exhaust line during air injection, thus inviting excessive air consumption.

Restricting the flow of air through the throttle valve in the apparatus of Publication 61-225348 reduces peak pressure of air injection by the main weft inserting nozzle, thereby affecting the flying speed of inserted weft. Since the weft flying speed should be set in close relation to the speed of the loom, it is difficult to satisfy at a time both requirements of such weft flying speed and the desired pressure rise of air injection only through adjustment of the above throttle valve.

Accordingly, it is an object of the present invention to provide a weft insertion control apparatus in a jet loom which can insert a weak or hard twist weft without inviting an increase in air consumption and reducing the peak pressure of air injection.

MEANS SOLVING THE PROBLEMS

According to the invention of the first claim, the above object can be achieved by a control apparatus which comprises an air supply control valve disposed in an air supply line and connected to a weft inserting nozzle of the loom via the air supply line for controlling supply of air under pressure to the weft inserting nozzle, an air exhaust line branching off from the air supply line between the air supply control valve and the weft inserting nozzle, a flow control valve disposed in the air exhaust line, and an air exhaust control valve disposed in the air exhaust line and operable to open during an early period of air injection by the weft inserting nozzle for each weft insertion.

The invention of the second claim provides a weft insertion control apparatus which comprises an air supply control valve disposed in an air supply-line and connected to a weft inserting nozzle via the air supply line for controlling supply of air under pressure to the weft inserting nozzle, and air pressure buffer means disposed

in the air supply line and having formed therein a variable-volume space between the weft inserting nozzle and the air supply control valve.

OPERATION OF THE INVENTION

In the apparatus according to invention of the first claim, part of air flown through the air supply control valve is allowed to escape through the air exhaust control valve which is opened simultaneously with opening of the air supply control valve. Changing the air flow through the air exhaust control valve by adjusting the flow control valve, the pressure rise of air injection by the weft inserting nozzle can be moderated as desired.

In the apparatus according to the invention of the second claim, air injection pressure of the main weft inserting nozzle can reach its peak pressure only when the variable-volume space in the air pressure buffer means is filled with air under supply pressure. Thus, the pressure rise of air injection by the weft inserting nozzle can be restricted as required by enlarging the volume of the air pressure buffer space.

EMBODIMENTS

The following will describe an embodiment of the weft insertion control apparatus according to the first invention with reference to FIGS. 1 to 5(b).

FIG. 1	is a schematic diagram showing an embodiment of weft insertion control apparatus according to the invention of the first claim;
FIG. 2	is a schematic diagram similar to FIG. 1, but showing a different state of the apparatus;
FIG. 3(a)	is a graph showing a waveform of air injection pressure change obtained with air exhaust control valve of the apparatus kept closed;
FIG. 3(b)	is a graph showing a similar waveform obtained when air supply control valve and air exhaust control valve of the apparatus are both opened;
FIG. 3(c)	is a graph showing a similar waveform obtained by another manner of opening the air exhaust control valve;
FIG. 4 (a) and Fig.4(b)	are schematic diagrams showing an embodiment of weft insertion control apparatus according to the invention of the second claim;
FIG. 5(a)	is a graph showing a waveform of air injection pressure change obtained in the state of the apparatus shown in FIG. 4(a);
FIG. 5(b)	is a graph showing a similar waveform, but obtained in the state of the apparatus shown in FIG. 4(b).

Referring to FIGS. 1 and 2 showing the apparatus schematically, reference numeral 1 designates a main weft inserting nozzle of a jet loom issuing air jet for inserting a weft Y into a warp shed. Numeral 2 depicts an air supply tank holding therein air under supply pressure P which is adjusted by a reducing valve 3. The main weft inserting nozzle 1 is connected to the air tank 2 through air supply conduit 4. A solenoid-operated valve 5 for controlling air supply to weft inserting nozzle 1 is disposed in the conduit 4.

The air supply conduit 4 between the nozzle 1 and the valve 5 has an air exhaust conduit 6 branching off therefrom and having therein a flow control valve 7. There is provided a solenoid-operated air exhaust control valve 8 between the flow control valve 7 and the connection between the conduits 4, 6. At the terminating end of the air exhaust conduit 6 is provided a silencer 9.

FIG. 1 shows a state of the apparatus wherein the valves 5, 8 are both closed and, therefore, no air is supplied to the main weft inserting nozzle 1. To activate, the nozzle 1 for inserting a weft Y, the valves 5, 8 are opened as shown in FIG. 2 by energizing their solenoids.

Referring to FIG. 3(b), square waveform M denotes a signal that causes the solenoid for the valve 5 to be energized and similar waveform S_1 a signal that causes the solenoid for the valve 8 to be energized, respectively. Waveform C_1 denotes a pressure change of air injection by the main weft inserting nozzle 1 taking place when the signals M, S_1 are applied to the solenoids to open the valves 5, 8 for periods indicated by the signals, respectively. The air injection pressure waveform C_1 consists of three portions, i.e. pressure rise C_{11}, pressure peak C_{12} and pressure fall C_{13}. The pressure peak C_{12} corresponds to supply pressure P of air in the tank 2 adjusted by the reducing valve 3. The air exhaust control valve 8 is opened simultaneously with opening of the air supply control valve 5, allowing part of air from the valve 5 to be exhausted through the conduit 6. By so exhausting part of air, the gradient of the pressure rise C_{11} of the air injection pressure waveform C_1 can become less steep. This gradient of pressure rise depends on the rate at which air is exhausted through the conduit 6. That is, the higher the rate is, the less steep the gradient of pressure rise C_{11} will be. The rate of air flowing through the exhaust conduit 6 can be changed by adjusting the flow control valve 7.

Waveform C_0 in FIG. 3(a) shows a pressure change of air injection by the main weft inserting nozzle 1 taking place when the air supply control valve 5 is opened as indicated by solenoid energizing signal M, while the air exhaust control valve 8 is kept closed. The peak pressure C_{02} in the waveform C_0 corresponds to the supply pressure P of air in the tank 2 adjusted by the reducing valve 3 and the gradient of pressure fall C_{03} is substantially the same as that of the pressure fall C_{13} in the waveform C_1. However, the inclination of the pressure rise C_{01} is steep as compared with C_{11} in the waveform C_1 in FIG. 3(b).

Allowing part of air flowing through the air supply control valve 5 to escape through the exhaust control valve 8 and the adjusted flow control valve 7 in the exhaust conduit 6 during an early period of air injection as indicated by signal S_1, the pressure rise of air injection by the main weft inserting nozzle 1 can become moderate enough, as shown by C_{11} in FIG. 3(b), for successful insertion of weak or hard twist weft. Because air exhausting through the conduit 6 takes place only during the early period of air injection by the weft inserting nozzle 1, air will not be consumed so much as in a method which allows air to be exhausted constantly while air supply control valve is opened.

It is to be understood that the manner of opening the air exhaust control valve 8 is not limited to that illustrated in FIG. 3(b). For example, as shown in FIG. 3(c), signal S_2 to energize the solenoid for the valve 8 may continue to be effective until the air injection pressure reaches its peak P or C_{22} in the waveform C_2. By thus lengthening the opened time of the valve 8, the pressure rise C_{21} can be further moderated than C_{11} in FIG. 3(b).

Additionally, the air exhaust control valve 8 may be opened at the end of the peak pressure C_{22}, as indicated by S_3 in FIG. 3(c), to make the pressure fall C_{23} steeper than C_{03}, C_{13} in FIG. 3 (a) and (b). Such control of air injection pressure can make air injection by residual pressure to take place for a shorter period, with the result that a break of a weak weft due to such air injection by residual pressure can be prevented.

Though the air exhaust control valve 8 in the embodiment of FIGS. 1 and 2 is illustrated as a solenoid-operated valve it may be substituted with any mechanical valve. In such a case, a clutch may be provided in a drive line between the drive source of the loom and the mechanical valve and the clutch is engaged when handling a weak or hard twist weft.

The following will describe an embodiment of the apparatus according to the invention of the second claim with reference to FIGS. 4 - 5. The apparatus includes an air pressure buffer tank 10 disposed in the air supply conduit 4 at a location between the main weft inserting nozzle 1 and the air supply control valve 5. The air pressure buffer tank 10 has an adjustably movable partition plate 11 to which an adjusting screw 11a is fixed. The screw 11a is engaged with a threaded hole formed in back wall of the tank 10. In such arrangement of the tank 10, an air pressure buffer space can be formed in the tank 10 whose volume can be variable by turning the adjusting screw 11a to move the plate 11 relative to the tank.

FIG. 4(a) shows a plate position where the air pressure buffer space in the tank 10 is minimum, while FIG. 4(b) shows a plate position where the buffer space is maximum. FIG. 5(a) shows a waveform C_3 of air injection pressure change of the main weft inserting nozzle 1 with the partition plate 11 positioned for minimum air pressure buffer space in the tank 10 shown in FIG. 4(a). FIG. 5(b) shows a similar waveform C_4 of air injection pressure change with the partition plate 11 positioned for maximum buffer space shown in FIG. 4(b). Square waveform M indicates application of an energizing signal to the solenoid of the air supply control valve 5.

Peak pressures C_{32} and C_{42} Of the waveforms C_3 and C_4, respectively, correspond to supply pressure P of air to the main weft inserting nozzle 1. The pressure rise C_{41} and pressure fall C_{43} in FIG. 5(b) obtained with the maximum volume of pressure buffer space in the tank 10 are less steep than the pressure rise C_{31} and pressure fall C_{33} in FIG. 5(a) obtained with the minimum volume of buffer space. When handling weak or hard twist weft, therefore, the buffer space volume in the tank 10 may be enlarged by adjusting the screw 11a so as to moderate the pressure rise of air injection.

The use of such air pressure buffer tank 10 is advantageous also in that air loss can be reduced.

EFFECT OF THE INVENTION

In the apparatus according to the first invention wherein part of air flown through the air supply control valve is allowed to escape through the air exhaust control valve and flow control valve in the air exhaust conduit, the pressure rise of air injection by the weft inserting nozzle can be moderated without inviting reduction of peak pressure and excessive loss of air.

In the apparatus invention according to the second claim wherein there is provided a variable-volume air pressure buffer space in the fluid supply line, the pressure rise of air injection by the weft inserting nozzle can be restricted without causing the peak pressure to be dropped and any loss of air.

The apparatus provides for a weft insertion control apparatus in a jet loom which permits successful insertion of weak or hard twist weft. Pressure of air in the air supply tank 1 is adjusted by reducing valve 3. The

main weft inserting nozzle 1 is connected to the air supply tank 1 through air supply conduit 4. There is provided a solenoid-operated air supply control valve 5 in the conduit 4. The air supply conduit 4 between the nozzle 1 and the valve 5 has an air exhaust conduit 6 branching off therefrom and having therein a flow control valve 7. There is provided a solenoid-operated air exhaust control valve 8 between the flow control valve 9 and the connection between the conduits 4, 6.

[DESIGNATION OF REFERENCE NUMERALS]

1 ... Main weft inserting nozzle; 4 ... Air pressure supply conduit; 5 ... Air supply control valve; 6 ... Air exhaust conduit; 7 ... Flow control valve; 8 ... Air exhaust control valve; 10 ... Air pressure buffer tank.

Claims

1. Weft insertion control apparatus in a jet loom having a nozzle (1) for inserting a weft (Y) into a warp shed by air jet injected therefrom, comprising an air supply control valve (5) disposed in an air supply line (4) and connected to said weft inserting nozzle via said air supply line for controlling supply of air under pressure to said weft inserting nozzle (1), an air exhaust line (6) branching off from said air supply line (4) between said air supply control valve (5) and said weft inserting nozzle (1), a flow control valve (7) disposed in said air exhaust line (6), and an air exhaust control valve ((8) disposed in said air exhaust line and operable to open during an early period of air injection by said weft inserting nozzle for each weft insertion.

2. Weft insertion control apparatus in a jet loom having a nozzle (1) for inserting a weft (Y) into a warp shed by air jet injected therefrom, comprising an air supply control valve (5) disposed in an air supply line (4) and connected to said weft inserting nozzle (1) via said air supply line (4) for controlling supply of air under pressure to said weft inserting nozzle (1), and air pressure buffer means (10) disposed in said air supply line (4) and having formed therein a variable-volume space between said inserting nozzle (1) and said air supply control valve (5).

3. Weft insertion control apparatus as claimed in claim 1 or claim 2, said air supply control valve (5) being solenoid operated electrical valves.

4. Weft insertion control apparatus as claimed in claim 1 and claim 3, said exhaust control valve (8) and/or flow control valve (7) being solenoid operated electric valves.

5. Weft insertion control apparatus as claimed in claim 1 or claim 2, said air supply control valve (5) and/or reducing valve (3) being fluid operated valves.

6. Weft insertion control apparatus as claimed in claim 1 and claim 5, said exhaust control valve (8) and/or flow control valve (7) being solenoid operated electric valves.

7. Weft insertion control apparatus as claimed in claim 2 or claim 3 and claim 5, said air buffer means (10) including variable buffer volume space means.

8. Weft insertion control apparatus as claimed in claim 7, further including electrically operated means (11) for varying said variable buffer volume in said buffer volume space means (10).

9. Weft insertion control apparatus as claimed in claim 7, further including fluid operated means (11) for varying said variable buffer volume in said buffer volume space means (10).

10. Air jet loom with a weft insertion control apparatus as claimed in any of claims 1 to 9.

Fig. 1

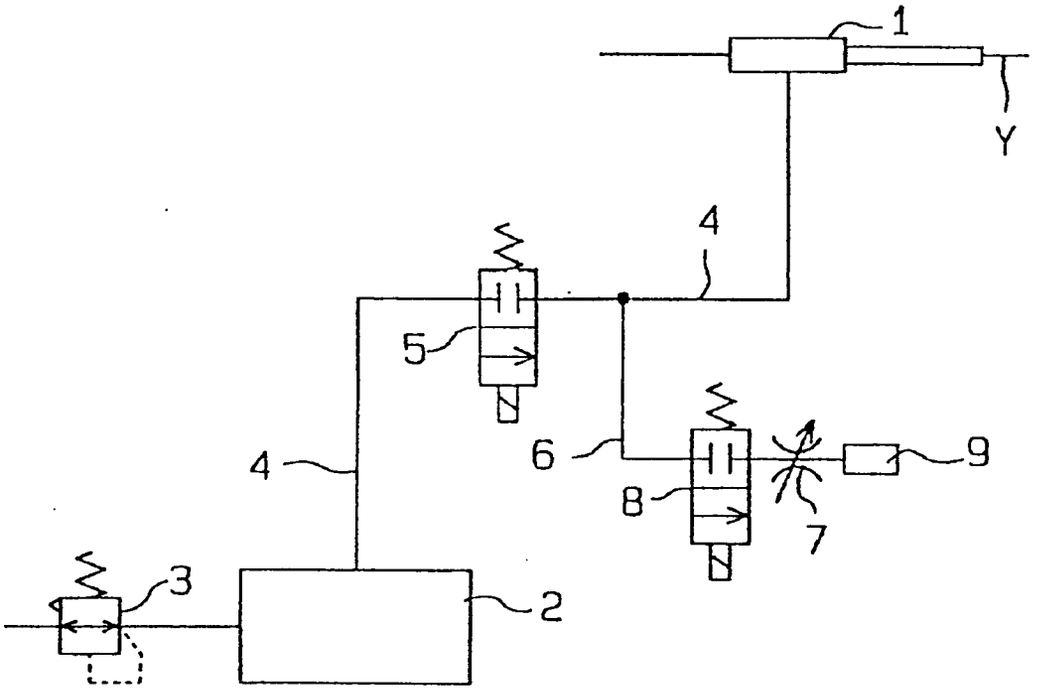


Fig. 2

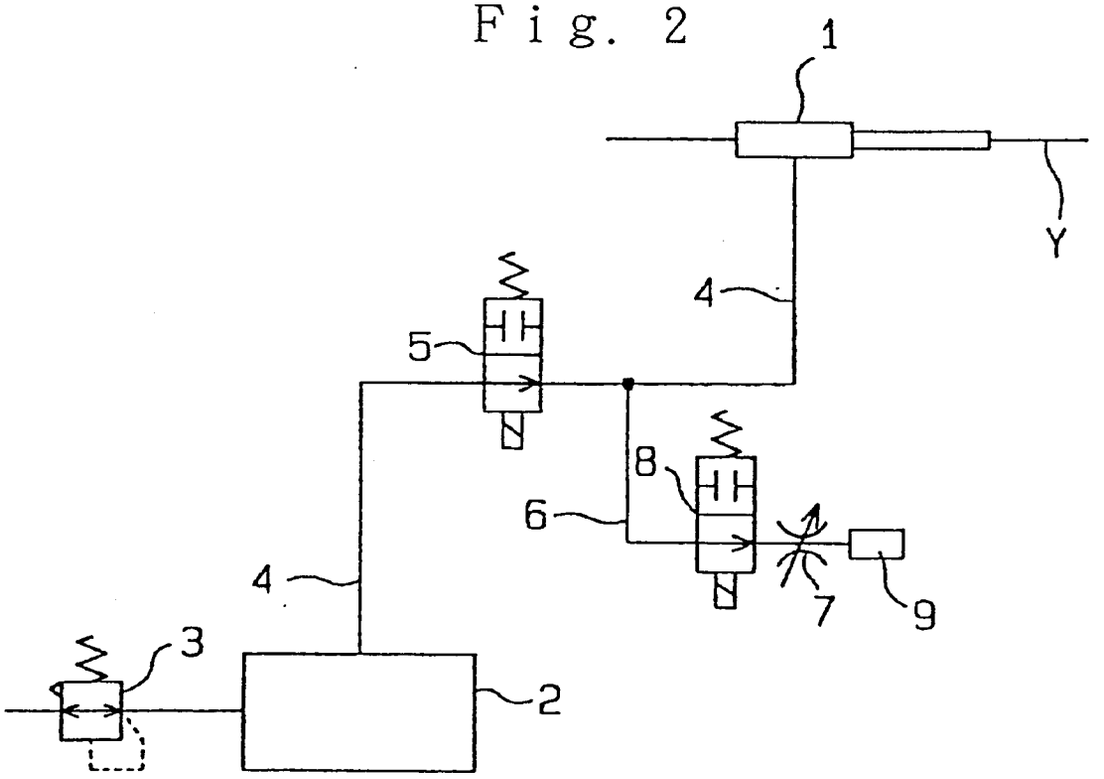


Fig. 3

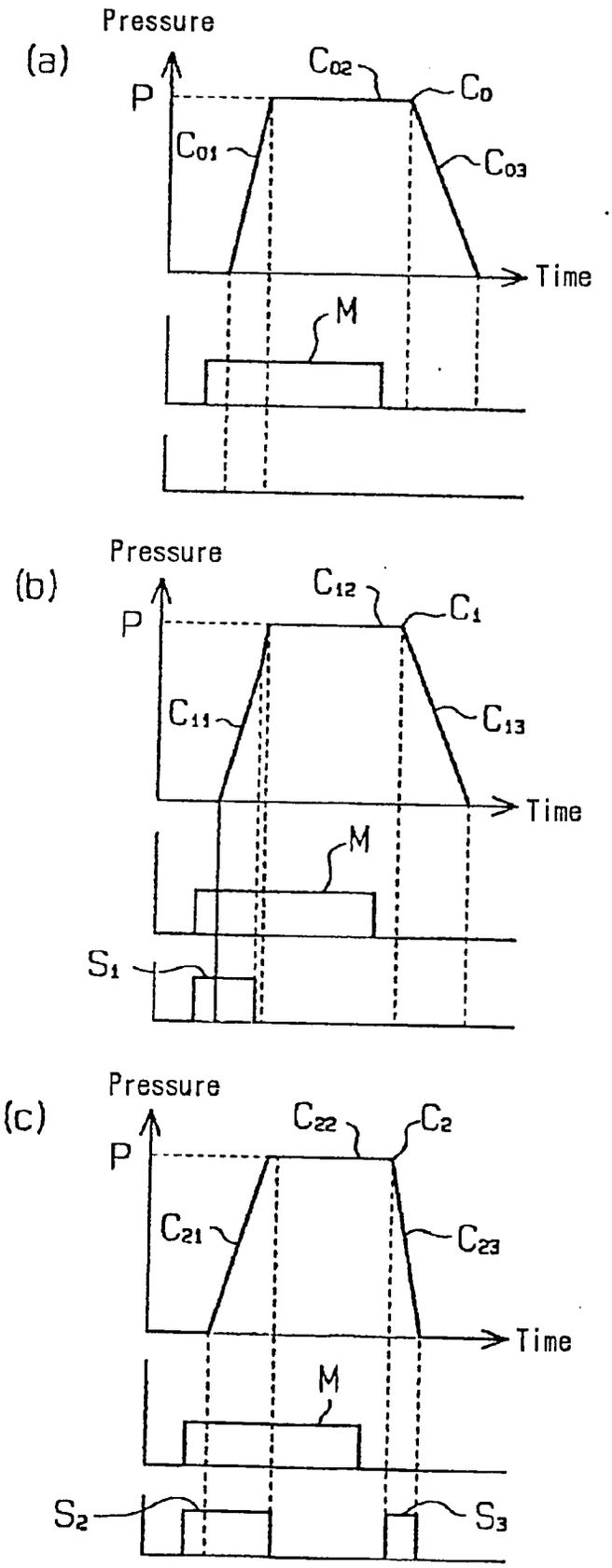

(a)
Pressure
P
C02
C0
C01
C03
Time
M
(b)
Pressure
P
C12
C1
C11
C13
Time
M
S1
(c)
Pressure
P
C22
C2
C21
C23
Time
M
S2
S3

Fig. 4

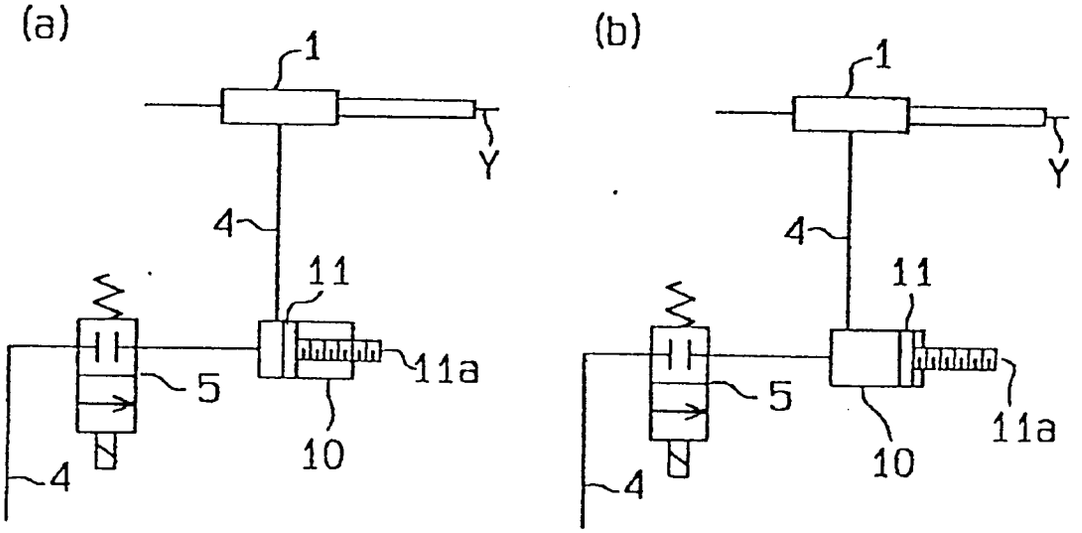
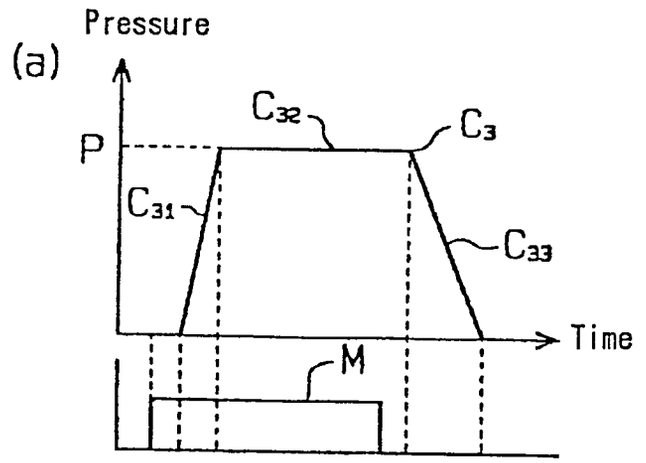

(a)
1
Y
4
11
11a
5
10
4
(b)
1
Y
4
11
5
11a
10
4

Fig. 5


Pressure
(a)
P
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C31
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Time
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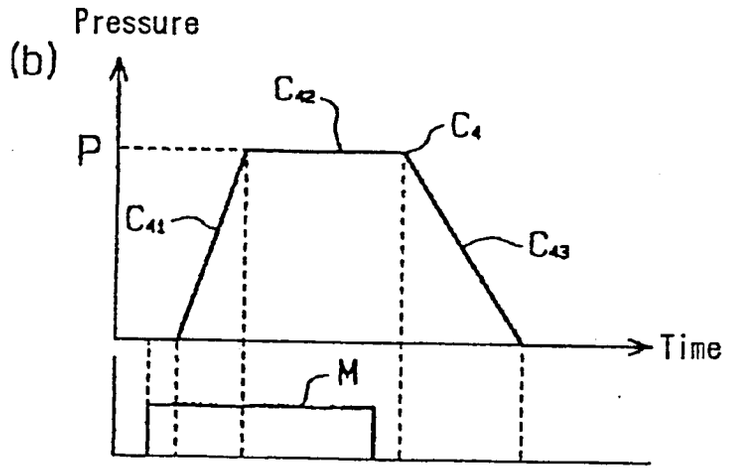
Pressure
(b)
P
C42
C4
C41
C43
Time
M

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 81 0643

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)
X A	US-A-4 303 106 (YOSHIDA) * the whole document * * column 6, line 5 - line 23; figure 1 *	1 3,4,6	D03D47/30
A	US-A-4 466 468 (BROUWER) * the whole document * * column 2, line 67 - column 3, line 25 *	1,3-6	
A,D	JP-U-59 193 882 (...) * figure 1 *	1	
A	EP-A-0 105 561 (RÜTI)		
A,D	JP-A-56 015 442 (...)		
A,D	DATABASE WPI Week 8646, Derwent Publications Ltd., London, GB; AN 86-302796 & JP-A-61 225 348 (TSUDAKOMA) 7 October 1986 * abstract *		

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	4 January 1994	Boutelegier, C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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