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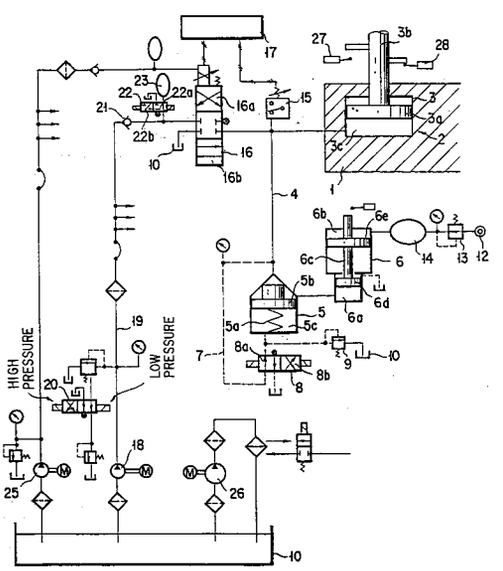
(54) **OUTER LOAD CONTROLLER OF PRESS.**

(57) An outer load controller of a press which is directed to obtaining high accuracy in pressure regulation and improving responsiveness. The controller includes a logic valve (5) which is connected between the hydraulic chamber (3c) of a hydraulic cylinder (3) disposed at each point (2) of an outer slide (1) and an overload protector (6) and which performs a relief function under overload, and a servo valve (16) controlled in accordance with a point generation load calculated at each descent position of the slide. An oil pressure inside the hydraulic chamber is variably controlled by the servo valve in the controller.

FIG. 1



EP 0 496 882 A1

FIELD OF THE INVENTION

This invention relates to an outer load control device for a double-acting mechanical press.

BACKGROUND OF THE INVENTION

In a conventional outer load contrl device provided on a double-acting mechanical press, a hydraulic chamber provided at a point of an outer slide is connected to a hydraulic chamber of a hydroblank holder, and a pressure of an air chamber of the hydroblank holder is controlled by an air regulator to thereby control the pressure of the hydraulic chamber at said point and that of the hydraulic chamber of said hydroblank holder.

However, in the aforementioned conventional outer load control device, since the pressure of the air chamber of the hydroblank holder is controlled by the regulator, there were drawbacks that the precision and responsiveness are low, and particularly, since the temperature of air varies when pressure is changed, the control is instable.

Furthermore, since the outer load is indirectly controlled through the hydroblank holder, there was a drawback that the precision and responsiveness are further degraded.

SUMMARY OF THE INVENTION

The present invention has been achieved in view of the aforementioned circumstances. An object of the present invention is to provide an outer load control device for a press which can obtain a high precision in regulating pressure and which has an improved responsiveness.

For achieving the aforesaid object, according to a first mode of the present invention, there is provided an outer load control device for a double-acting mechanical press provided with an inner slide and an outer slide, comprising a logic valve connected between a hydraulic chamber of a hydraulic cylinder provided at each point of said outer slide and an overload protector and having a relief function with respect to the overload, and a servo valve controlled in response to a point generation load calculated every down position of said inner slide, wherein the hydraulic pressure in said hydraulic chamber is variably controlled by said servo valve.

According to the present invention having the aforementioned mode, the point load of the outer slide is controlled according to the stroke position of the inner slide, and the hydraulic pressure of the hydraulic chamber is directly controlled under the state in which a portion between the hydraulic chamber provided at the point of the outer slide and the overload protector is shut off. Therefore, the pressure regulation with high precision can be made and the responsiveness is also improved.

The above-described object, other objects, modes and features of the present invention will become apparent for those skilled in the art from the ensuing description in which preferred specific embodiments matched to the principle of the present invention and the description in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a circuit of the whole configuration showing one specific embodiment according to the present invention;

Fig. 2 is an explanatory view showing the load distribution of the point; and

Fig. 3 is a flow chart showing the function of the specific embodiment according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

One embodiment of this invention will be described in detail with reference to the drawings. In an outer slide 1 provided on a double-acting mechanical press, points 2 are provided in plural, for example, four places, each of these points 2 being provided with a hydraulic cylinder 3.

A piston 3a received in each hydraulic cylinder 3 is connected to a plunger 3b, and a driving force from an outer slide driving mechanism not shown is transmitted to the outer slide 1 through the plunger 3b and hydraulic pressure in a hydraulic chamber 3c of the hydraulic cylinder 3.

The hydraulic chamber 3c of the hydraulic chamber 3 is connected to a hydraulic chamber 6a of an overload protector 6 through a line 4 and a logic valve 5.

The logic valve 5 has a valve body 5b urged in a closing direction by a compression spring 5a. Pressure of the line 4 is introduced toward the spring chamber 5b through a pilot line 7 and a solenoid valve 8, and an overload relief valve 9 is provided between the spring chamber 5b and the solenoid valve 8 so that at the time of overload, pressure in the spring chamber 5b is drained to a tank 10.

The overload protector 6 has a hydraulic chamber 6a and an air pressure chamber 6b having a larger area than that of the hydraulic chamber 6a. These hydraulic chamber 6a and the air pressure chamber 6b house therein pistons 6d and 6e, respectively, connected by a piston rod 6c. Air of constant pressure is supplied from an air source 12 to the air pressure chamber 6b through an air regulator 13 and an air tank 14, and the interior of

the hydraulic chamber 6a is pressurized by said air pressure through the pistons 6d and 6e.

A pressure sensor 15 and a servo valve 16 are connected halfway of the line 4 which connects between the hydraulic chamber 3c of the hydraulic cylinder 3 and the logic valve 5.

The pressure chamber 15 detects pressure within the hydraulic chamber 3c to output a detected value to a control device 17, and the servo valve 16 is controlled by the control device 17 so as to control hydraulic pressure supplied from a hydraulic pump 18 to the hydraulic chamber 3c through a line 19.

A preload switching valve 20 which switches a preload pressure supplied to the hydraulic chamber 3c into two stages, a high pressure and a low pressure, is connected to a discharge side of the hydraulic pump 18, and an accumulator 23 is connected to a downstream side of a check valve 21 through a solenoid valve 22.

In the drawing, reference numeral 25 designates an operating oil pump for supplying an operating pressure to the servo valve 16; 26, a cooling pump for cooling an operating oil in the tank 10; 27, a limit switch mounted in the vicinity of the plunge 3b to detect a stroke lmit of the outer slide 1; and 28, a limit switch for detecting a hydrozone.

In Fig. 2, reference numeral 30 designates a balancer for urging the outer slide 1 upwardly, and 31 designates a mold mounted on the outer slide 1.

The operation of the specific example according to the present invention will be described hereinbelow with reference to a flow charte shown in Fig. 3. Load patterns R_1 to R_1 with respect to a stroke $\underline{s}$ of the inner slide are set as set values in the control device 17. A stroke of the inner slide, air pressure in the air pressure chamber 6b of the overload protector 6 and the balancer 30, and a balancer raising force $\underline{r}$ at the bottom dead center of the slide are inputted from an encoder provided on a rotary cam and a stroke detector 33 such as a linear scale mounted on the inner slide.

In the case where the overload protector 6 is used to perform molding similar to prior art, the solenoid valve 8 is set to a position 8b to drain pressure in the spring chamber 5c whereby the logic valve 5 is opened to switch the preload pressure switching valve 20 to the low pressured side.

The servo valve 16 is set to a position 16a to set a set load to a maximum value, and the solenoid valve 22 is set to a position 22b to disconnect the accumulator 23 from the line 19.

Molding is carried out under this state to maximize the outer load, and the outer slide 1 can be driven.

Next, in the case where molding is carried out with the outer load to be variable, the solenoid valve 8 is set to a position 8a, the logic valve 6 is closed, and the preload pressure switching valve 20 is switched to the high pressure side.

The solenoid valve 22 is set to a position 22a, and the accumulator 23 is connected to the line 19. Pressure of the air regulator 13 for supplying air to the air pressure chamber 6b of the overload protector 6 is set to zero.

When molding starts from the aforesaid state, the outer slide 1 first moves down to the bottom dead center, and a peripheral portion of the blank is held by a blank holder (not shown) on the side of the lower mold resiliently supported on a die cushion not shown.

On the other hand, the control device 17 calculates point generation loads F_1 to F_4 at respectively points from slide weights W_1 to W_4 and mold weights W_1 to W_4 at respective points 2 by the following formula in accordance with the flow chart shown in Fig. 3.

$$F_{1-4} = R_{1-4} + r/4 - W_{1-4} - w_{1-4}$$

The point generation loads at respective positions of the inner slide are obtained from a value in which a slide stroke S' is corrected by the following formula from a stroke S of the inner slide and the number of revolutions N of a main motor.

$$S' = S - kN$$ (K is a proportional constant.)

The point loads at the respective positions of the inner slide obtained as described above are amplified by an amplifier and sent to the servo valve 16. Hydraulic pressure in the hydraulic chamber 3c of the hydraulic cylinder 3 is controlled by the servo valve 16, and hydraulic pressure in the hydraulic chamber 3c is detected by the pressure sensor 15 and fed back to the control device 17.

When an overload occurs in the outer slide 1 during operation, the overload relief valve 9 is relived so that the logic valve 5 is opened.

Thereby, the hydraulic pressure in the hydraulic chamber 3c is drained from the logic valve 5 to thee overload protector 6 to avoid overload. Since the pressure sensor 15 detects that the hydraulic pressure in the hydraulic chamber 3c abnormally lowers, the servo valve 16 is switched from the position 16a to 16b, and the hydraulic pressure within the hydraulic chamber 3c is drained to the tank 10.

In the case where there is an error in adjustment of die height, the hydrozone detecting limit switch 28 detects this error during operation to give an alarm. The stroke limit detecting limit switch 27 also gives an alarm when an abnormal condition occurs in the hydraulic system or when the adjustment of die height is erroneous.

Claims

1. An outer load control device for a double-acting mechanical press provided with an inner slide and an outer slide, comprising a logic valve connected between a hydraulic chamber of a hydraulic cylinder provided at each point of said outer slide and an overload protector and having a relief function with respect to the overload, and a servo valve controlled in response to a point generation load calculated every down position of said inner slide, wherein the hydraulic pressure in said hydraulic chamber is variably controlled by said servo valve.

2. The outer load control device according to claim 1, wherein when the hydraulic pressure of said hydraulic chamber is variably controlled by said servo valve, pressure of an air regulator for supplying a presssure-regulated air to an air pressure chamber of the overload protector is set to zero.

3. The outer load control device according to claim 1, wherein the hydraulic pressure supplied to the hydraulic chamber of each of said points is corrected by the urging force of a balancer, a weight distribution of mold and a load distribution of the slide.

FIG. 1

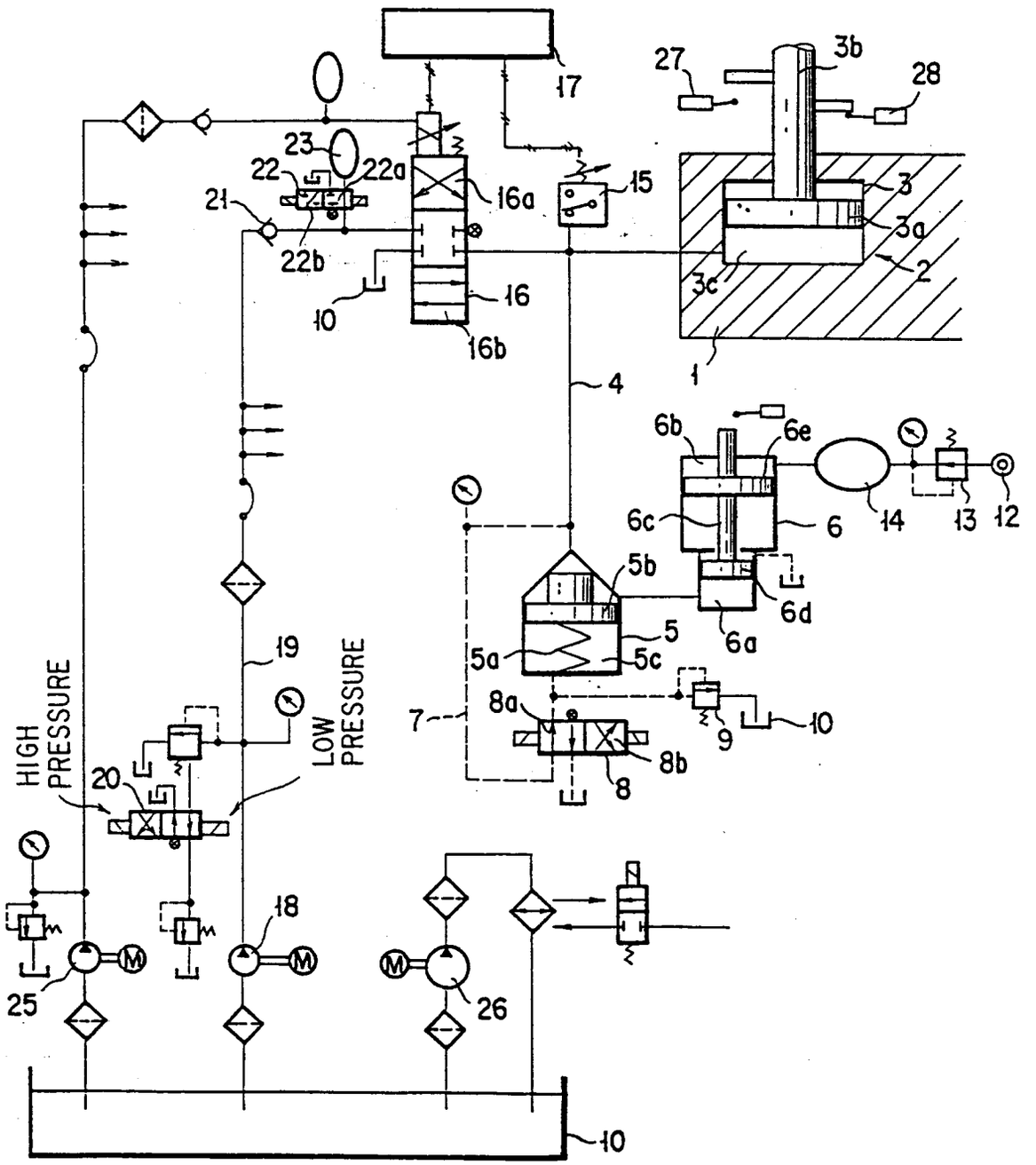

17
27
3b
28
23
22
22a
16a
15
21
22b
3
3a
2
3c
10
16
16b
1
4
6b
6e
6c
6
14
13
12
5b
6d
6a
5
5a
5c
7
8a
9
10
8b
8
19
HIGH PRESSURE
LOW PRESSURE
20
18
25
26
10

FIG. 2

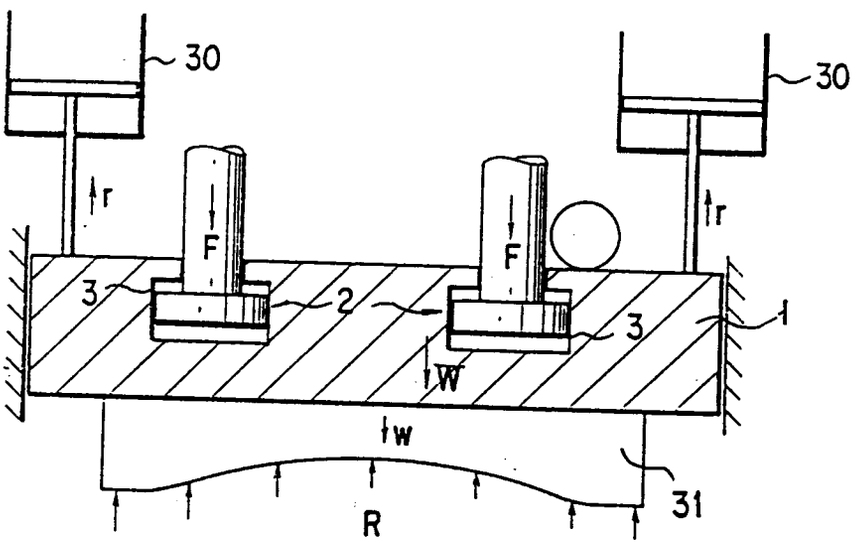
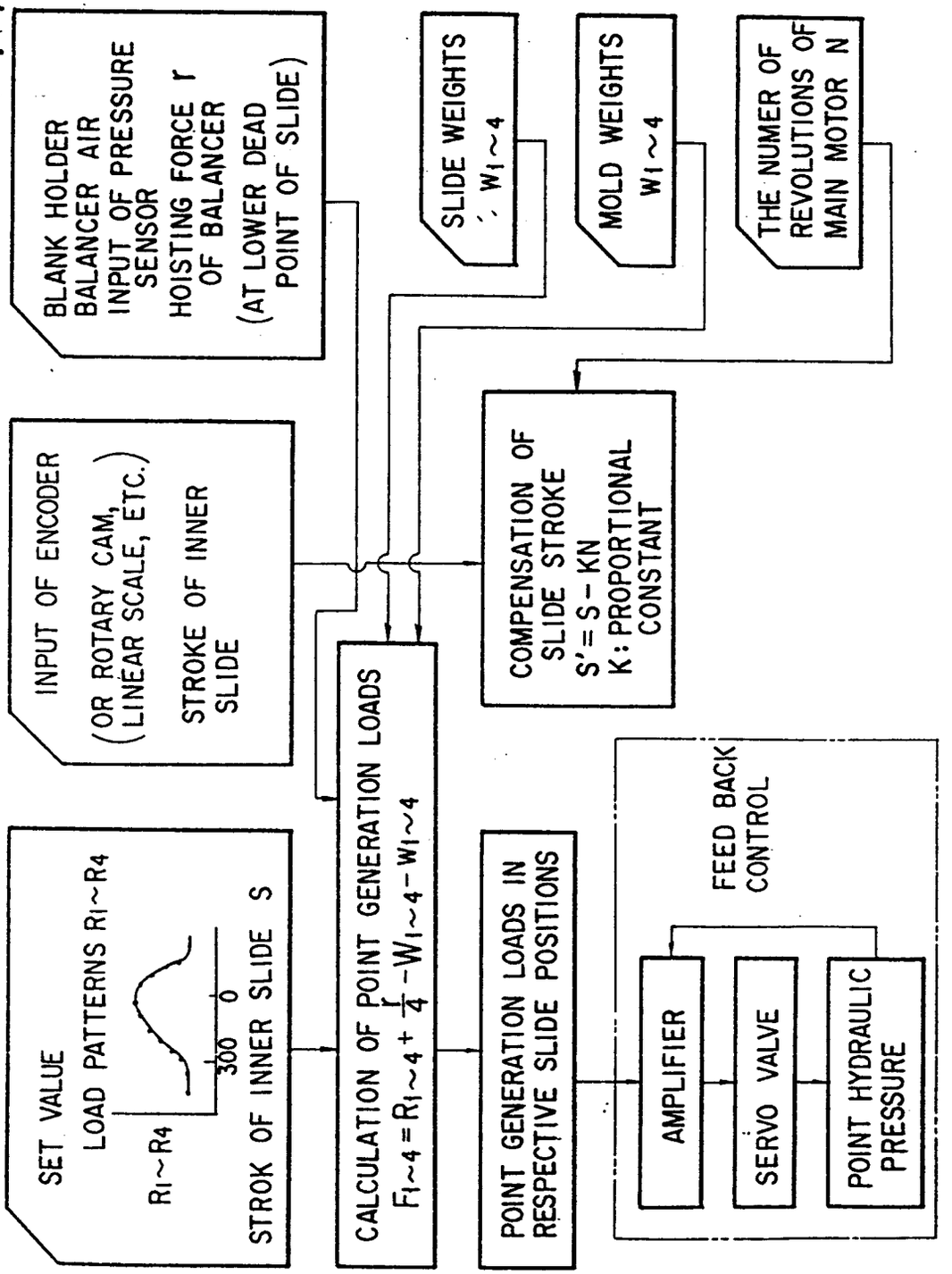


FIG. 3


SET VALUE
LOAD PATTERNS R1~R4
R1~R4
300
0
STROK OF INNER SLIDE S
INPUT OF ENCODER
(OR ROTARY CAM, LINEAR SCALE, ETC.)
STROKE OF INNER SLIDE
BLANK HOLDER
BALANCER AIR
INPUT OF PRESSURE SENSOR
HOISTING FORCE r OF BALANCER
(AT LOWER DEAD POINT OF SLIDE)
SLIDE WEIGHTS W1~4
MOLD WEIGHTS W1~4
THE NUMER OF REVOLUTIONS OF MAIN MOTOR N
CALCULATION OF POINT GENERATION LOADS
F1~4 = R1~4 + r/4 - W1~4 - W1~4
COMPENSATION OF SLIDE STROKE
S' = S - KN
K: PROPORTIONAL CONSTANT
POINT GENERATION LOADS IN RESPECTIVE SLIDE POSITIONS
FEED BACK CONTROL
AMPLIFIER
SERVO VALVE
POINT HYDRAULIC PRESSURE

INTERNATIONAL SEARCH REPORT

International Application No PCT/JP90/00914

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl[5] B30B15/22, 15/28, 1/26

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	B30B15/22, 15/28, 1/26

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

Jitsuyo Shinan Koho 1926 - 1990
Kokai Jitsuyo Shinan Koho 1971 - 1990

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	JP, U, 62-46198 (Toyota Motor Corp.), 20 March 1987 (20. 03. 87), (Family: none)	1 - 3
Y	JP, A, 62-151300 (Komatsu Ltd.), 6 July 1987 (06. 07. 87) & US, A, 4,760,781	1 - 3
A	JP, B, 62-3720 (Toyota Motor Corp.), 26 January 1987 (26. 01. 87), (Family: none)	1 - 3

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
September 11, 1990 (11. 09. 90)	September 25, 1990 (25. 09. 90)
International Searching Authority	**Signature of Authorized Officer**
Japanese Patent Office	