



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

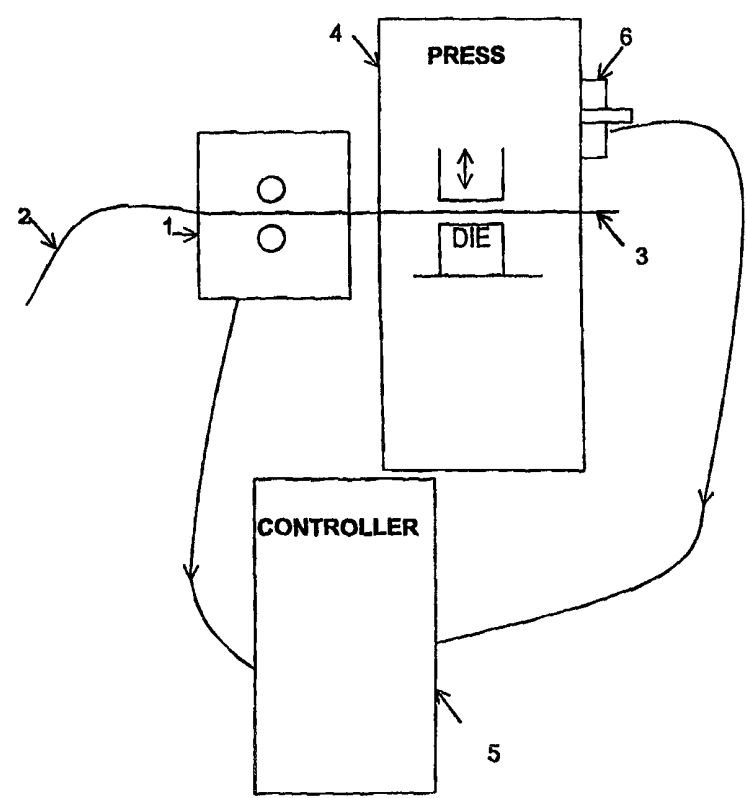
<p>(51) International Patent Classification <sup>6</sup> : <b>B30B 15/30, B26D 5/20</b></p>	<p><b>A1</b></p>	<p>(11) International Publication Number: <b>WO 99/36251</b> (43) International Publication Date: 22 July 1999 (22.07.99)</p>
---	------------------	---

<p>(21) International Application Number: PCT/US99/00064 (22) International Filing Date: 5 January 1999 (05.01.99) (30) Priority Data: 09/006,135 13 January 1998 (13.01.98) US (71) Applicant: VAMCO INTERNATIONAL, INC. [US/US]; 555 Epsilon Drive, Pittsburgh, PA 15238 (US). (72) Inventors: WELSH, Scott, D.; 2004 Old Orchard Place, Gibsonia, PA 15044 (US). LUKAS, Daniel, G.; 617 Ravencrest Road, Pittsburgh, PA 15215 (US). MARTIN, Vaughn, H.; 3126 Seneca Court, Gibsonia, PA 15044 (US). (74) Agents: BYRNE, Richard, L. et al.; Webb Ziesenheim Bruening Logsdon Orkin &amp; Hanson, P.C., 700 Koppers Building, 436 Seventh Avenue, Pittsburgh, PA 15219-1818 (US).</p>	<p>(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>With international search report.</i></p>
---	--

(54) Title: METHOD OF COMPENSATING FOR SHUT HEIGHT VARIATION

(57) Abstract

A method for compensating for the variation in shut height of a press (4) during stamping and forming as it is starting and stopping comprising user input of the minimum press speed at which feeding (1) of feed material (2) to the press (1) should commence, monitoring (6) of the actual press speed, and feeding (1) of the feed material (2) only when a minimum press speed representing a desired press shut height has been achieved. A method for inputting a desired shut height range, monitoring (7) actual shut height and feeding (1) feed material (2) only when the actual shut height is within the desired shut height range is also disclosed.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

## METHOD OF COMPENSATING FOR SHUT HEIGHT VARIATION

### FIELD OF THE INVENTION

The present invention relates generally to a  
5 method for compensating for variation in shut height of a  
press in a stamping or forming operation when the press  
or machine is stopped or started.

### BACKGROUND OF THE INVENTION

When stamping or forming parts with a press,  
10 the formed or coined dimensions of the parts are  
dependent on the shut height of the press remaining  
constant. To ensure that the formed or coined dimensions  
of the parts are acceptable, it is desired that the shut  
height of the press remain constant or be within a  
15 certain tolerance dictated by the nature of the parts.  
Some precision forming or coining operations, such as  
those relating to the manufacture of electrical  
connectors, require that the shut height of the press be  
held to plus or minus 0.005 mm. If the shut height does  
20 not remain constant, part dimensions will vary, possibly  
outside of allowable tolerances.

Due to thermal and other factors, shut height normally varies slowly as the press runs at constant speed. As the press is stopping and starting, however, the press is operating at a lower speed than the constant  
5 speed the press attains during steady state operation and the shut height varies. This shut height variation during starting and stopping is due mainly to dynamic forces.

The typical shut height variation with press  
10 speed in strokes per minute (spm) as a high speed press starts up is depicted in FIG. 1. As depicted in FIG. 2, for the operation of a typical press during a particular run, the shut height drops from its initial value at start up at time A to a steady state value within a  
15 desired shut height range at time B. From time A to time B, the press speed rises from zero (0) to some relatively constant steady state press speed. During steady state operation from time B to time C, the shut height and press speed remain relatively constant until the press  
20 begins to stop at time C. From the initiation of the stopping of the press at time C until the time the press is stopped at time D, the shut height increases while the press speed decrease to zero (0).

The variation in shut height while a press is starting and stopping, as depicted in FIG. 2, means that part dimensions will vary more, possibly out of tolerance values for the parts, as the press is starting and stopping between time A and B and between time C and D.

Shut height variation occurs in presses operating at all speeds. However, shut height variation is much more pronounced, particularly while the press is starting and stopping, for presses operating at higher press speeds (generally above 600 spm).

Technology currently exists for maintaining a constant shut height as a press is running at constant, steady state operational speed. Until the present invention, no technology has existed for compensating for the variation in shut height as a press stops and starts and the press speed is varying. Current technology requires that material be fed to the press while the press is starting and stopping and the press shut height is varying, thereby producing bad, out of tolerance parts due to the varying shut height. The present invention eliminates the production of bad, out of tolerance parts due to varying shut heights as the press is starting and stopping.

## SUMMARY OF THE INVENTION

Disclosed is a method for compensating for the variation in shut height of a press as it is starting and stopping comprising user input of the minimum press speed at which feeding of a strip of material out of which the parts are to be coined or stamped, the feed material, should commence, monitoring of the press speed, and feeding of the feed material only when constant, steady state press speed and shut height has been achieved.

A method for compensating for the variation in shut height of a press as it is starting and stopping comprising inputting a desired shut height range at which feeding of the feed material should commenced, monitoring of the actual shut height, and feeding of the feed material only when the shut height is within the desired shut height range is also disclosed.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a graph of shut height versus press speed during start up of a high speed press.

FIG. 2 is a graph of press speed and shut height versus time for a typical press.

FIG. 3 is a schematic of a preferred embodiment of the invention.

FIG. 4 is a schematic of another preferred embodiment of the invention.

5 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A press feed 1 is typically used to feed strips of the feed material 2 that will be stamped or formed to make the parts 3 to the press 4 as depicted in FIG. 3 in schematic form. In a preferred embodiment, the press  
10 feed 1 is an electronically controlled and electronically powered press feed device.

A controller 5 is directly connected to the press feed 1 and the press feedback device 6 which is connected to the press 4. In a preferred embodiment, the  
15 controller 5 is capable of controlling the press feed 1, receiving feedback information from the press feedback device 6, and accepting input from the user specifying the minimum press speed at which the press feed 1 should operate. In a preferred embodiment of the method, the  
20 controller 5 is capable of accepting direct user input of the minimum press speed. In other preferred embodiments of the method, the controller 5 is capable of accepting

an analog or digital signal representing the minimum  
press speed from a user supplied device (not shown). In  
another preferred embodiment, the controller 5 is capable  
of receiving a digital on/off signal from a user supplied  
5 auxiliary controller (not shown) which signals when the  
press shut height has stabilized.

In a preferred embodiment, the press 4  
incorporates and is connected to a press feedback device  
6 capable of measuring the speed of the press 4 while the  
10 press is operating, including when the press 4 is  
stopping and starting. In a preferred embodiment, the  
press feedback device is a resolver (not shown). In  
another preferred embodiment the press feedback device 6  
is a velocity feedback device (not shown).

15 The minimum press speed at which the electronic  
press feed 1 should begin feeding of the strip of  
material 2 out of which the parts 3 are to be stamped or  
formed is input by a user into the controller 5 prior to  
the commencement of operation of the press 4 and press  
20 feed 1. The operation of the press 4 is then started.

The speed at which the press 4 is operating is  
then measured by the press feedback device 6 of the press  
4 which in turn transmits the press speed information

back to the controller 5. The controller 5 then compares the speed of the press 4 with the inputted minimum press speed. If the speed of the press 4 is greater than or equal to the inputted minimum press speed, the controller 5 sends a signal to the press feed 1 to start feeding the feed material 2 into the press 4 which will stamp or form the parts 3. If the speed of the press 4 is lower than the inputted minimum press speed, the controller 5 sends a signal to the press feed 1 to remain out of operation or stop feeding the feed material 2.

Once the speed of the press 4 has met or exceeded the minimum press speed, the speed of the press 4 is continually monitored by the press feedback device 6 and compared with the inputted minimum press speed by the controller 5. Should the speed of the press 4 be measured at a value below the inputted minimum press speed at anytime during the operation of the press 4, the controller 5 will send a signal to the press feed 1 to stop feeding the feed material 2. While the press 4 is stopping, the controller 5 will likewise send a signal to the press feed 1 to stop feeding the feed material 2 when the measured press speed sent by the press feedback device 6 back to the controller 5 is below the inputted minimum press speed.

In another preferred embodiment shown in FIG. 4, the press 4 incorporates a press feed back device 7 capable of measuring the shut height of the press 4 while the press 4 is operating, including when the press 4 is stopping and starting. In this preferred embodiment the controller 5 is capable of accepting direct user input of the required shut height range. In another version of this preferred embodiment the controller 5 is capable of accepting an analog or digital signal representing the required shut height range from a user supplied device (not shown).

The required press shut height at which the press feed 1 should begin feeding of the strip of material 2 out of which parts 3 are to be stamped or formed is input into the controller 5 prior to the commencement of operation of the press 4 and press feed 1. The operation of the press 4 is then started after the required press shut height is input.

The shut height at which the press 4 is operating is then measured by the shut height feedback device 7 of the press 4 which in turn transmits the shut height information back to the controller 5. In this preferred embodiment, the feedback device 7 is a linear displacement transducer. The controller 5 then compares

the shut height of the press 4 with the inputted desired shut height range. If the measured shut height is within the desired range specified, the controller 5 sends a signal to the press feed 1 to feed material 2. The  
5 controller 5 continually monitors the press shut height via the feedback device 7. If at anytime during operation of the press 4, the shut height deviates outside the specified range, controller 5 signals the press feed 1 to stop feeding material 2.

10 In a third preferred embodiment, when it is sufficient to prevent the production of bad parts at press start up and not at press stoppage, the feedback device 7 may be replaced with a stroke-counter (not shown). The user inputs a value representing the number  
15 of press strokes to skip during start up to the controller 5. The controller 5 then compares the number of press strokes counted by the stroke-counter and transmitted to the controller 5 to the inputted number of press strokes to skip. When the number of press strokes  
20 counted by the stroke-counter exceeds the inputted number of press strokes to skip, the controller 5 signals the press feed 1 to begin feeding the feed material 2.

In a preferred embodiment of the embodiments described above, the press 4 is a high speed punch press,

with tooling. Other embodiments may involve other forms of presses with various operational speeds because shut height variation occurs for presses operating at any speed. In a preferred embodiment of the embodiments  
5 described above, the press 4 is a electronically controlled and electronically powered press feed.

The embodiments described above are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is indicated by  
10 the following claims rather than the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

## WHAT IS CLAIMED IS:

1. A method for compensating for the variation in shut height of a press as it is starting and stopping comprising:

5                   input of the minimum press speed of said press at which feeding of the feed material should commence;

                  continuous monitoring of the actual press speed of said press; and

                  feeding of said feed material by a press feed  
10 only when said actual press speed is at least equal to said minimum press speed.

2. The method of claim 1 wherein said feeding of said feed material by said press feed is stopped when said actual press feed is less than said minimum press  
15 speed.

3. The method of claim 1 wherein said press is a high speed punch press.

4. The method of claim 1 wherein the continuous monitoring of said actual press speed is  
20 performed by a resolver.

5. The method of claim 1 wherein the press feed is an electronically controlled and electronically powered press feed.

6. The method of claim 1 wherein said minimum press speed is a press speed at which said shut height of said press is within a desired tolerance value.

5 7. The method of claim 1 wherein said minimum press speed is input by direct user input into a controller for said press.

8. The method of claim 1 wherein said minimum press speed is input into a controller for said press by digital signal from a user supplied auxiliary controller.

10 9. A method for compensating for the variation in shut height of a press as it is starting and stopping comprising:

15 input of the minimum press speed of said press at which feeding of the feed material should commence to a controller;

continuous monitoring of the actual press speed of said press;

feedback of said actual press speed of said press to said controller by a feedback device;

20 comparison of said actual press speed of said press with said minimum press speed of said press by said controller;

25 sending a signal from said controller to a press feed to begin feeding said feed material to said press when said actual press speed of said press is at least equal to said minimum press speed; and

sending a signal from said controller to said press feed to stop feeding said feed material to said press when said actual press speed of said press is less than said minimum press speed.

5                   10. The method of claim 9 wherein said press is a high speed punch press.

11. The method of claim 9 wherein said feedback device is a resolver.

10                   12. The method of claim 9 wherein the press feed is an electronically controlled and electronically powered press feed.

13. The method of claim 9 wherein said minimum press speed is a press speed at which said shut height of said press is within a desired tolerance value.

15                   14. The method of claim 9 wherein said minimum press speed is input by direct user input into said controller.

20                   15. The method of claim 9 wherein said minimum press speed is input into said controller by digital signal from a user supplied auxiliary controller.

16. A method for compensating for the variation in shut height of a press as it is starting and stopping comprising:

25                   input of the desired shut height range of said press at which feeding of the feed material should commence;

continuous monitoring of the actual shut height of said press; and

feeding of said feed material by a press feed only when said actual shut height is within the desired shut height range.

17. The method of claim 16 wherein said press is a high speed punch press.

18. The method of claim 16 wherein the continuous monitoring of said actual shut height is performed by a linear displacement transducer.

19. The method of claim 16 wherein the press feed is an electronically controlled and electronically powered press feed.

20. The method of claim 16 wherein said desired shut height range is a shut height of said press that enables parts to be produced within a desired tolerance value.

21. The method of claim 16 wherein said desired shut height range is input by direct user input into a controller for said press.

22. The method of claim 16 wherein said desired shut height range is input into a controller for said press by digital signal from a user supplied auxiliary controller.

23. A method for compensating for the variation in shut height of a press as it is starting and stopping comprising:

5 input to a controller of the desired shut height range of said press at which feeding of the feed material should commence;

continuous monitoring of the actual shut height of said press;

10 feedback of said actual shut height of said press to said controller by a feedback device;

comparison of said actual shut height of said press with said desired shut height range of said press by said controller;

15 sending a signal from said controller to a press feed to begin feeding said feed material to said press when said actual shut height of said press is at least within said desired shut height range; and

20 sending a signal from said controller to said press feed to stop feeding said feed material to said press when said actual shut height of said press is outside of said desired press shut height range.

24. The method of claim 23 wherein said press is a high speed punch press.

25 feedback device is a linear displacement transducer.

26. The method of claim 23 wherein the press feed is an electronically controlled and electronically powered press feed.

5 27. The method of claim 23 wherein said desired shut height range is a shut height of said press that ensures that the parts produced by said press are within a desired tolerance value.

10 28. The method of claim 23 wherein said desired shut height range is input by direct user input into said controller.

29. The method of claim 23 wherein said desired shut height range is input into said controller by digital signal.

15 30. The method of claim 23 wherein said desired shut height range is input into said controller by analog signal.

**PRESS SHUT HEIGHT VS. SPEED DURING STARTUP**

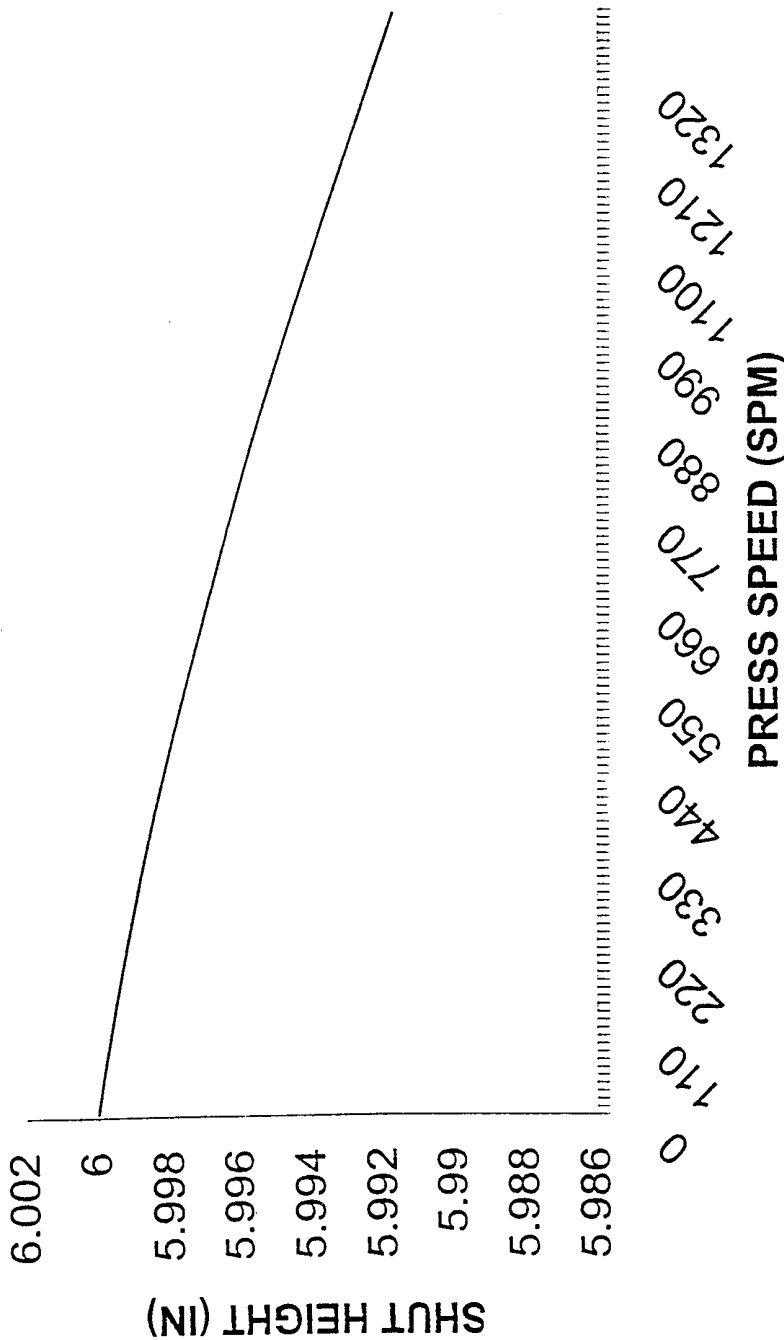
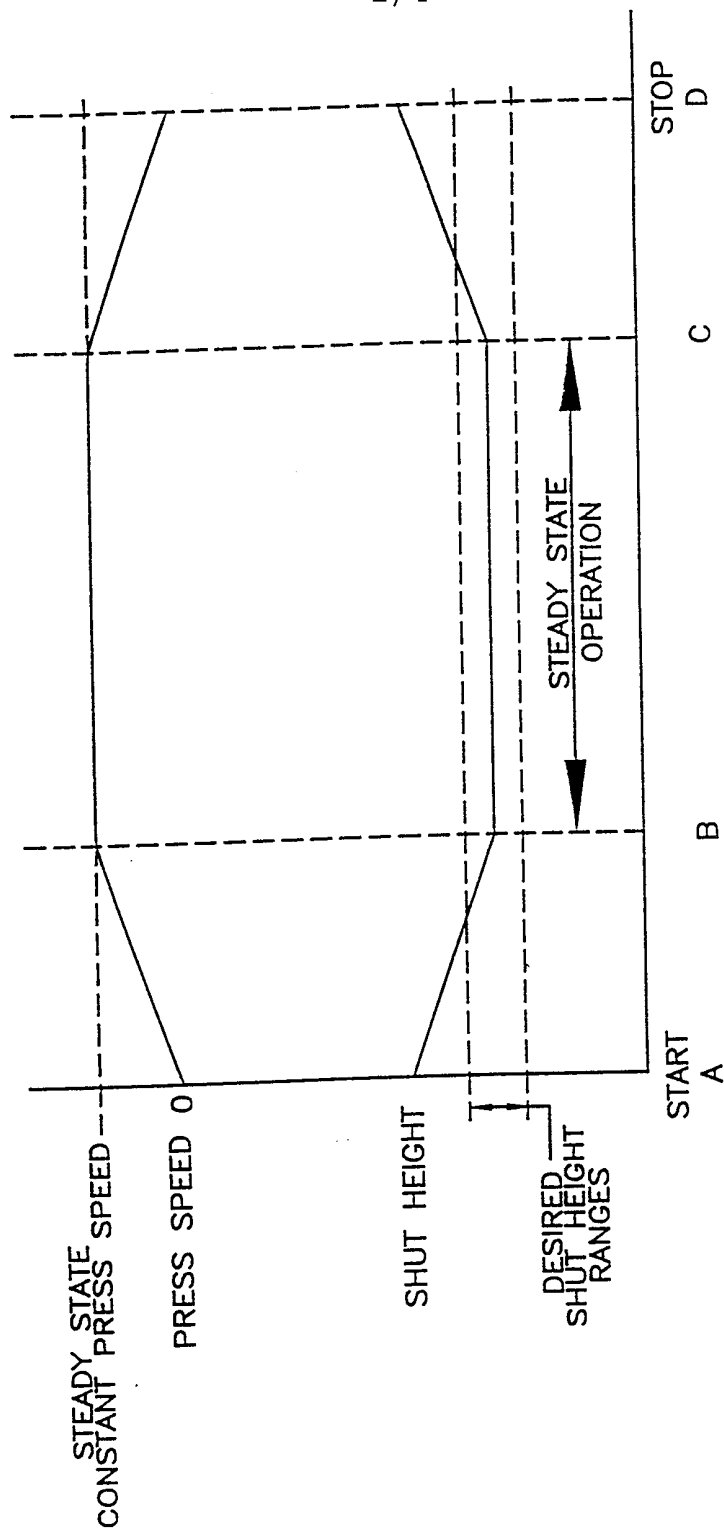


FIG. 1



TIME

FIG. 2

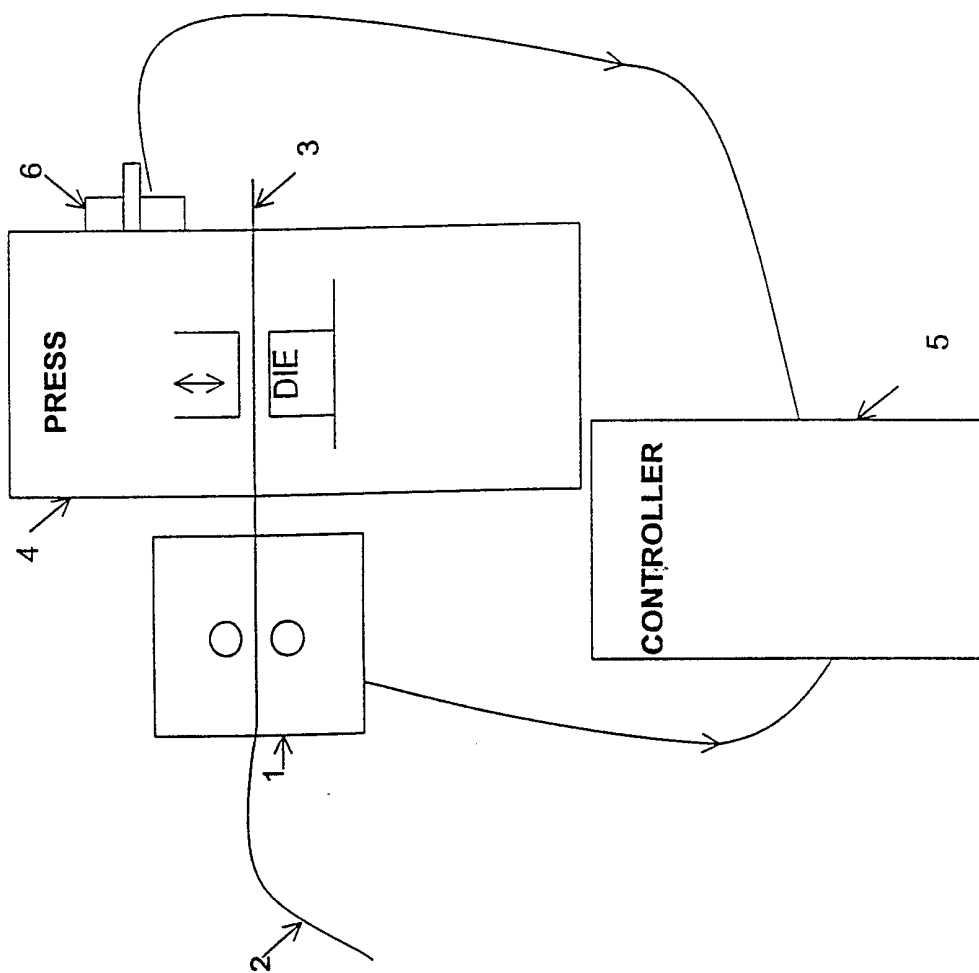


FIG. 3

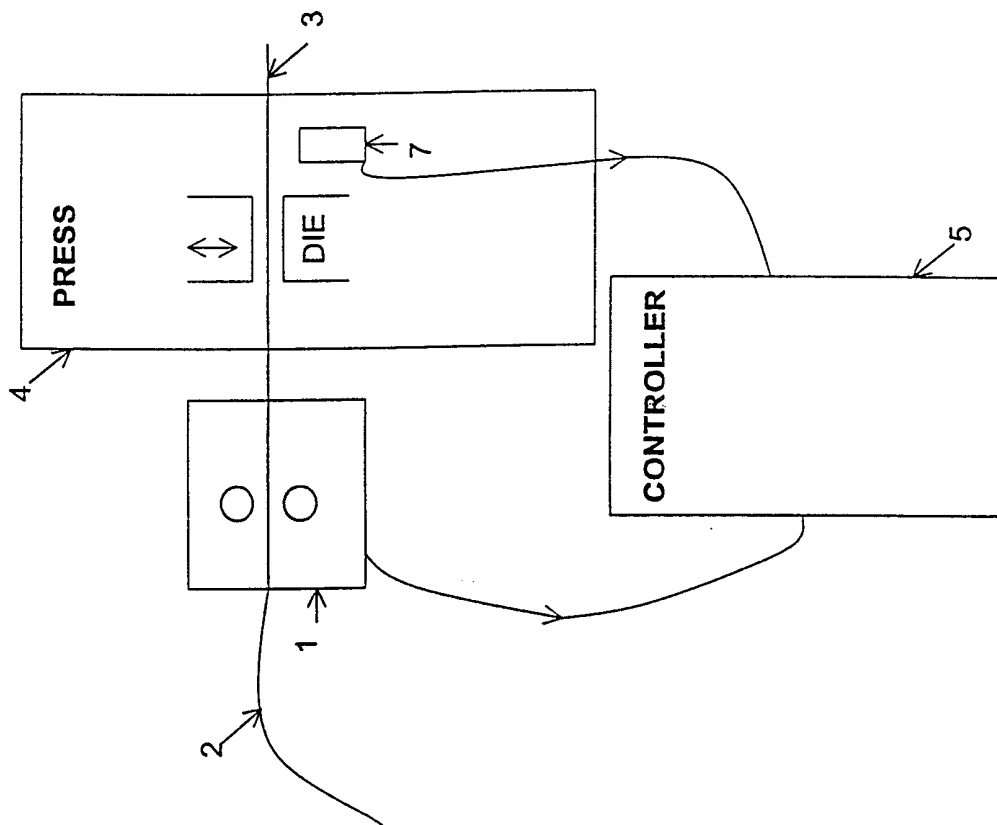


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/00064

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) :B30B 15/30; B26D 5/20

US CL :100/35, 45, 257; 72/448; 83/13, 530

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 100/35, 43, 45, 53, 215, 216, 257; 72/17.2, 19.8, 20.1, 20.2, 421, 443, 448; 83/13, 373, 403.1, 530, 734

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3,557,686 A (SAPOLSKY) 26 January 1971, see col. 3, lines 23-29 and 67-71.	1-15
A	US 4,387,632 A (HEIBERGER) 14 June 1983, see abstract.	1-15
A	US 4,480,538 A (YOSHIDA) 06 November 1984, see figure 3 and abstract.	16-30
A	US 5,699,688 A (ALLRED) 23 December 1997, see col. 7, lines 49-67.	1-30
A	JP 4-270098 A (AMADA CO LTD) 25 September 1992, see constitution.	1-30

Further documents are listed in the continuation of Box C.  See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"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
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

22 FEBRUARY 1999

Date of mailing of the international search report

03 MAR 1999

Name and mailing address of the ISA/US  
Commissioner of Patents and Trademarks  
Box PCT  
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

STEPHEN F. GERRITY

Telephone No. (703) 308-1279

*Shelia V. Vasey*  
*Patent Specialist*  
*Technology Center 3700*