



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**23.05.2001 Bulletin 2001/21**

(51) Int Cl.7: **B26F 1/02**, B26F 1/24,  
B26D 5/00, B26D 5/16

(21) Application number: **00125144.6**

(22) Date of filing: **17.11.2000**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU**  
**MC NL PT SE TR**  
Designated Extension States:  
**AL LT LV MK RO SI**

(72) Inventors:  

- Yano, Tetsuo, Ando Electric Co., Ltd. Kawasaki-shi, Kanagawa (JP)
- Kudoh, Tetsuya, Ando Electric Co., Ltd. Kawasaki-shi, Kanagawa (JP)
- Ohta, Yasunori, Ando Electric Co., Ltd. Kawasaki-shi, Kanagawa (JP)

(30) Priority: **17.11.1999 JP 32712699**

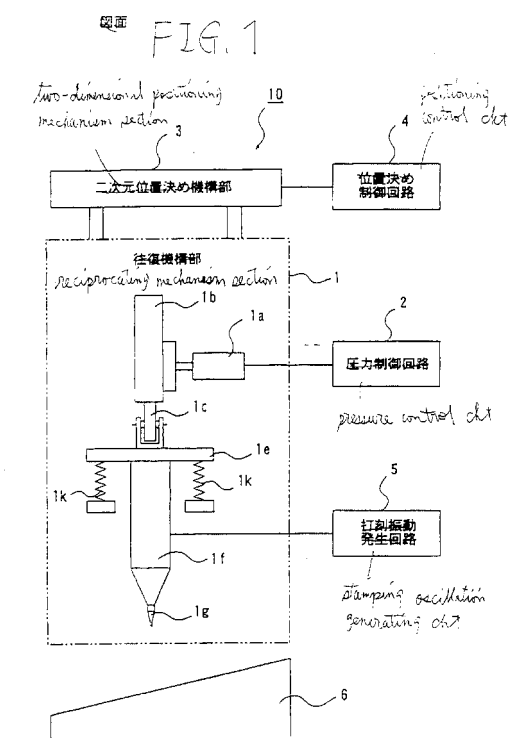
(71) Applicant: **Ando Electric Co., Ltd.**  
**Kawasaki-shi, Kanagawa (JP)**

(74) Representative: **Grünecker, Kinkeldey,**  
**Stockmair & Schwanhäusser Anwaltssozietät**  
**Maximilianstrasse 58**  
**80538 München (DE)**

(54) **Punching apparatus and punching method**

(57) In a stamping apparatus, a subtracter 22b and an adder 23b compare an output value of an amplifier 29 which is a signal proportional to [T] expressing the torque generated at a fulcrum 101 by the reaction force [F] from the material to be stamped 6, to a pulse · duty setting value stored in a pulse · duty setting section 21b, and a signal

in which the difference is added to the pulse · duty setting value, is generated, and a switch 25 inputs the signal into a comparator 24b in order to make the signal the comparison signal to the chopping wave outputted from a chopping wave generation circuit 26' in the PWM pulse generation circuit 26.



## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

**[0001]** The present invention relates to a stamping apparatus and a stamping method to stamp the production number or product name on the surface of metallic or synthetic resin material parts.

#### 2. Description of the Related Art

**[0002]** As the conventional stamping apparatus, for example, as disclosed in Japanese Patent Examined Publication No. Hei 3-27397, a carving press with a pressing force adjustment mechanism by which the stamping depth becomes uniform by applying a predetermined air pressure on a pressing bar by a pressure regulator, without depending on the inclination or curved surface, is well known.

**[0003]** However, in the conventional stamping apparatus, in order to keep the pressure applying onto the pressing bar constant, it is necessary that the movement speed and pressing force of a pen attached on the tip of the pressing bar are adjusted, by manually changing the setting of the pressure of the pressure regulator, or by arranging a speed regulation valve at the inlet or outlet of the compressed air of the supply pipe. Accordingly, it is necessary that the pressure applied onto the pressing bar is adjusted corresponding to the characteristics of the material to be stamped such as the material, shape, or hardness, therefore, it requires much labor and time.

**[0004]** Further, in order to automatically control the applying pressure adjustment, it is necessary that a pressure sensor to detect the pressing force of the pen is provided, and the speed regulation valves at the inlet and outlet of the compressed air of the supply pipe and the pressure regulator are automatically controlled, however, as the complexity and the size of the structure of the apparatus are increased, the cost becomes expensive. Further, because air is the compressive fluid, the responsibility of the pneumatic control is low, thereby, the realization of the automatic control is difficult.

### SUMMARY OF THE INVENTION

**[0005]** An object of the present invention is to provide a stamping apparatus and a stamping method, by which the automatic control of the applying pressure onto a material to be stamped is realized by the low cost and easy structure.

**[0006]** In order to attain the above object, according to a first aspect of the invention, there is provided a stamping apparatus (for example, a stamping apparatus 10 in Fig. 1) comprising: a stamping means (for example, a reciprocating mechanism section 1 in Fig. 1) for

stamping on a processing surface of a material to be stamped by reciprocally moving a stamping section (for example, stylus 1g in Fig. 1); a stamping section moving means (for example, a two-dimensional positioning mechanism section 3 in Fig. 1) for moving the stamping section in two-dimensional direction to the processing surface; and an applying pressure adjustment means (for example, a pressure control circuit 2 in Fig. 1) for causing the stamping section to maintain a predetermined pressure onto the processing surface, wherein the stamping apparatus is provided with a cam apparatus to reciprocally move the stamping section linearly when it is driven by the cam rotated by a driving means (for example, a motor 1a in Fig. 1).

**[0007]** According to the first aspect of the invention, the stamping means stamps on the processing surface of the material to be stamped by reciprocally moving the stamping section; the stamping section moving means moves the stamping section in the two-dimensional direction to the processing surface; the applying pressure adjustment means adjusts the applying pressure so that a predetermined pressure is kept onto the processing surface; and the stamping means has the cam apparatus to reciprocally move the stamping section linearly when the cam in the stamping means is rotated by the driving means and the stamping section is driven by the cam.

**[0008]** Accordingly, the pressing force applied on the material to be stamped is directly detected by using the reaction force from the stamping section, and this pressing force can be kept constant, therefore, the stamping apparatus by which the applying pressure can be adjusted, can be realized by the easy and small sized structure.

**[0009]** According to a second aspect of the invention, the stamping apparatus according to the first aspect further comprises a contact detection means (for example, a current amount detection resistance 28 in Fig. 4) for detecting the pressure of the stamping section onto the processing surface by the change of a current value flowing through the driving means; and the applying pressure adjustment means (for example, a pressure control circuit 2 in Fig. 1) adjusts the pressure onto the processing surface according to the detection result, when the contact of the stamping section with the processing surface is detected by the contact detection means.

**[0010]** According to the second aspect of the invention, the contact detection means detects the contact of the stamping section with the processing surface by the change of a current value flowing through the driving means, and the applying pressure adjustment means adjusts the applying pressure onto the processing surface according to the detection result, when the contact of the stamping section with the processing surface is detected by the contact detection means.

**[0011]** According to a fifth aspect of the invention, there is provided a stamping method comprising: a

stamping step of reciprocally moving the stamping section linearly when it is driven by the cam rotated by a driving means; a stamping section moving step of moving the stamping section in the two-dimensional direction to the processing surface; a contact detection step of detecting the contact of the stamping section with the processing surface by the change of a current value flowing through the driving means; and an applying pressure adjustment step of causing the stamping section to maintain a predetermined applying pressure onto the processing surface, according to the detection result, when the contact of the stamping section with the processing surface is detected by the contact detection process.

**[0012]** According to the fifth aspect of the invention, in the stamping step, the stamping section driven when the cam is rotated by the driving means, is reciprocally moved linearly; in the stamping section moving step, the stamping section is moved in the two-dimensional direction to the processing surface; in the contact detection step, the contact of the stamping section with the processing surface is detected by the change of the current value flowing through the driving means; and in the applying pressure adjustment step, when the contact of the stamping section with the processing surface is detected in the contact detection step, according to the result of the detection, the pressure is adjusted so that the stamping section maintains the predetermined applying pressure onto the processing surface.

**[0013]** Accordingly, in addition to the effect of the first aspect of the invention, the material to be stamped can be stamped by the optimum speed and pressing force, corresponding to the difference in the weight of the stamping means or the contact position with the processing surface.

**[0014]** According to a third aspect of the invention, the stamping apparatus according to the first or second aspect further comprises alarm output means (for example, an amplifier 29 in Fig. 4) for outputting the alarm, when it is detected that the stamping section does not contact with the processing surface by the contact detection means, at the time of reciprocating movement of the stamping section by the stamping means (for example, the reciprocating mechanism section 1 in Fig. 1).

**[0015]** According to the third aspect of the invention, the alarm output means outputs the alarm, when it is detected that the stamping section does not contact with the processing surface by the contact detection means, at the time of reciprocating movement of the stamping section by the stamping means.

**[0016]** According to a sixth aspect of the invention, the stamping method according to the fifth aspect further comprises an alarm output step of outputting the alarm, when it is detected that the stamping section does not contact with the processing surface in the contact detection process, at the time of reciprocating movement of the stamping section in the stamping step.

**[0017]** According to the sixth aspect of the invention,

in the alarm output step, the alarm is outputted, when it is detected that the stamping section does not contact with the processing surface in the contact detection step, at the time of reciprocating movement of the stamping section in the stamping step.

**[0018]** Accordingly, in addition to the effects according to the first, second, or fifth aspect of the invention, because the user can quickly recognize that the stamping means is at the position at which the stamping can not conduct onto the material to be stamped, thereby, the time and electric power consumption can be saved.

**[0019]** According to the fourth aspect of the invention, in the stamping apparatus according to the first aspect, the stamping means (for example, the reciprocating mechanism section 1 in Fig. 1) has a cam with a cam curve by which the torque applied onto the driving means by the contact of the stamping section with the processing surface becomes constant without depending on the contact position with the processing surface.

**[0020]** According to the fourth aspect of the invention, the stamping means has a cam with a cam curve by which the torque applied onto the driving means by the contact of the stamping section with the processing surface becomes constant without depending on the contact position with the processing surface.

**[0021]** Accordingly, in addition to the effect according to the first aspect of the invention, by keeping the torque applied onto the driving means constant, the stamping can be conducted in an uniform depth without depending on the contact position of the stamping section with the processing surface.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0022]**

Fig. 1 is a view showing the schematic structure of a stamping apparatus 10 in an embodiment to which the present invention is applied;

Fig. 2 is an outline perspective view of a reciprocating mechanism section 1 in Fig. 1;

Fig. 3 is a view showing the dynamic relationship of a cam 1b and a cam follower 1c in Fig. 1; and

Fig. 4 is a circuit structural diagram of a pressure control circuit 2 in Fig. 1.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0023]** Referring to Fig. 1 - Fig. 4, a stamping apparatus 10 in an embodiment to which the present invention is applied, will be described below. Initially, the structure will be described. Fig. 1 is a view showing the schematic structure of the stamping apparatus 10 in an embodiment of the present invention.

**[0024]** In Fig. 1, the stamping apparatus 10 is approximately structured by a reciprocating mechanism section 1, pressure control circuit 2, two-dimensional posi-

tioning mechanism section 3, positioning control circuit 4 and stamping oscillation generating circuit 5. Further, the reciprocating mechanism section 1 is structured by a motor 1a, cam 1b, cam follower 1c, dog 1d, holding portion 1e, pen 1f, stylus 1g, up-movement end detector 1h, down-movement end detector 1i, shaft 1j, coil spring 1k, fixed plate 1l, stopper 1m, bearing 1n, and the like.

**[0025]** The motor 1a is attached on the fixed plate 1l, and when the motor 1a is driven and the cam 1b is rotated, the holding portion 1e is linearly moved through the cam follower 1c. The holding portion 1e is fixed on two shafts 1j, and is always pressed onto the cam 1b side by the coil spring 1k. Therefore, as the cam is rotated, even when the holding portion 1e is pressed and lowered toward the material to be stamped 6 side, or even when the holding portion 1e is separated from the material to be stamped 6 side, the holding portion 1e is moved following the cam 1b.

**[0026]** Further, within the movable range, the cam 1b has the shape in which the stylus 1g attached on the tip portion of the pen 1f can be pushed onto the material to be stamped 6 by a predetermined pressure by the predetermined torque from the motor 1a, without depending on its rotation position. The stylus 1g is made of the material having the higher hardness than the material to be stamped 6, and by being oscillated in the up and down directions at high speed, point stamping is repeated onto the material to be stamped 6.

**[0027]** A bearing 1n is housed in the fixed plate 1l, and the shaft 1j is guided by the bearing 1n, and linearly moved. Further, the cam follower 1c and the pen 1f are attached onto the holding portion 1e, and the up movement end detector 1h detects the dog 1d when the tip of the pen 1f attached on the bottom surface of the holding portion 1e is at the position of the up-movement end, and the down movement end detector 1i detects the dog 1d at the position of the down-movement end.

**[0028]** The pressure control circuit 2 controls the speed of the reciprocating movement of the pen 1f by controlling the rotation speed of the motor 1a, as will be described later. Further, the pressure control circuit 2 detects the arrival to the material to be stamped 6 when the pen 1f comes into contact with the material to be stamped 6 during the reciprocating movement of the pen 1f, and after the contact of the pen 1f with the material to be stamped 6, the pressure control circuit 2 controls the pressure of the stylus 1g applied onto the material to be stamped 6 so that it becomes a predetermined value. Further, when the stylus 1g reaches the down-movement end without contacting with the material to be stamped 6, the pressure control circuit 2 reversely rotates the motor 1a, and when the stylus 1g reaches the up-movement end, the pressure control circuit 2 stops the motor 1a, and outputs the alarm.

**[0029]** The two-dimensional positioning mechanism section 3 positions the two-dimensional pattern such as characters or numerals in the perpendicular direction to the stamping axis, according to the positioning control

signal outputted from the positioning control circuit 4. Thereby, the reciprocating mechanism section 1 causes the pen 1f to contact with pressure with the material to be stamped 6 under the condition that the pen 1f is oscillated, and stamps the characters and numerals on the material to be stamped 6. The stamping oscillation generating circuit 5 causes the pen 1f to generate the oscillation.

**[0030]** Next, the operation will be described.

**[0031]** Initially, referring to Fig. 3, the dynamic relationship of the cam apparatus will be described below. In Fig. 3, a fulcrum 101 expresses the fulcrum of the cam 1b which is a rotation shaft of the motor 1a, and the contact point 102 expresses the contact point of the cam 1b with the cam follower 1c. Further, [R] expresses the distance between the fulcrum 101 and the contact point 102, [F] is the reaction force from the material to be stamped 6, and [T] expresses the torque which is generated in the fulcrum 101 by [F]. Further, [α] expresses an angle formed between the direction of the reaction force [F] and the direction of the reaction force of the cam follower 1c to the cam 1b, [β] is an angle formed between the direction of [F] and the direction of [R], and [γ] expresses an angle formed between the direction of [F] and the direction of [F/cos α] respectively.

**[0032]** In this case, the torque [T] generated at the fulcrum 101 by the reaction force [F] from the material to be stamped is determined by the resultant force [F/cos α] of the reaction force [F] from the mechanism section to regulate the central axis of the cam follower 1c to the linear movement and the vertical distance [R sin γ] from the fulcrum 101 to the linear line, and the following relational expressions are obtained between them:

$$T = (F/\cos \alpha) \times R \sin \gamma \quad (1)$$

$$\gamma = \alpha + \beta \quad (2)$$

**[0033]** In these expressions, [F] and [T] are given, and the initial values of [R], [α], and [β], in which the arrangement of parts are considered at a appropriate position within a movable range of the pen 1f, are determined. In this case, in the change of the position in a degree within the movable range, because [α] is slightly changed, the relationship of [R] and [β] is obtained by the expression (1). Thereby, the cam curve by which [F] and [T] become constant, is obtained.

**[0034]** Accordingly, the cam 1b is formed with the curved shape to satisfy the above expression, and when the distance between the fulcrum 101 and the contact point 102 is appropriately changed as the rotation of the cam 1b, the pressure to be applied onto the material to be stamped 6 when a predetermined torque is applied from the motor 1a, can be kept constant. Incidentally, strictly, as the change of the length of the coil spring 1k, [F] is changed, however, because the change of [F] is

extremely small as compared to the pressure applied onto the material to be stamped 6, it can be neglected.

[0035] Next, referring to Fig. 4, the operation of the pressure control circuit 2 will be described. Initially, the speed control method of the pen 1f will be described.

[0036] Initially, by attaching a tachometer 1a' to the motor 1a, the rotation speed of the motor 1a is detected, and by a subtracter 22a and an adder 23a, the signal in which the difference between the detection result and a pulse duty setting value stored in a setting section 21a, is added to the setting value, is generated.

[0037] Next, a switch 25 inputs this signal into a comparator 24b so as to make this signal a comparing signal with the chopping wave outputted from a chopping wave generation circuit 26' in a PWM pulse generation circuit 26. Thereby, the rotation speed of the motor 1a is controlled so that the output signal of the tachometer 1a' keeps a value which is previously set in the pulse-duty setting section 21a. According to the above operation, the pressure control circuit 2 can control the speed of reciprocating movement of the pen 1f to the arbitrary speed.

[0038] Next, an arrival detection method of the pen 1f will be described. Although, when a DC servo motor is used as the motor 1a, the current value is proportional to the torque, because the movement is restrained when the stylus 1g comes into contact with the material to be stamped 6, the torque of the motor 1a temporarily becomes excessive. Accordingly, by inputting the voltage of both ends of the current amount detection resistance 28 into the amplifier 29, the voltage is detected, and compared to the torque setting value of the torque setting section 21c previously stored by the comparator 24a, thereby, the arrival to the material to be stamped 6 is detected. Then, when the arrival to the material to be stamped 6 is not detected, the amplifier 29 stops the motor 1a and outputs the alarm. According to the above operations, the pressure control circuit 2 can detect the contact of the pen 1f with the material to be stamped 6 during the movement in the reciprocating motion.

[0039] Next, the applying pressure control method of the pen 1f will be described. Initially, the subtracter 22b and the adder 23b compare the output value of the amplifier 29, which is a signal proportional to the [T], to the pulse-duty setting value stored in the pulse-duty setting section 21b, and the signal in which the difference is added to the pulse-duty setting value, is generated.

[0040] Next, the switch 25 inputs this signal into the comparator 24b so as to make this signal the comparing signal to the chopping wave outputted from the chopping wave generation circuit 26' in the PWM pulse generation circuit 26. Accordingly, the torque of the motor 1a is controlled so that the output signal of the amplifier 29 becomes the value which is previously set to the pulse-duty setting value of the pulse-duty setting section 21b. According to the above operations, the pressure control circuit 2 can control the pressure applied onto the material to be stamped 6 by the pen 1f, to the pre-

determined value. As described above, when the pressure control circuit 2 controls the switch 25 according to the signal to detect the arrival to the material to be stamped 6, because the difference of the weight of the pen 1f does not influence on the intensity of the collision with the material to be stamped 6, various kinds of pens can be used. Further, the pressure control circuit 2 can conduct the speed control and applying pressure control of the pen 1f so that the pressing force of the stylus 1g becomes the optimum value, thereby, the stamping apparatus by which the homogeneous stamping is conducted onto the processing surface without depending on the material and the shape of the material to be stamped 6, can be structured inexpensively and easily.

[0041] According to the invention of the first aspect, because the reaction force from the stamping section is used and the pressing force applied onto the material to be stamped is directly detected, and the pressing force can be kept constant, thereby, the stamping apparatus by which the applying pressure can be adjusted, can be realized in easy and small sized structure.

[0042] According to the invention of the aspect 2 or aspect 5, in addition of the effect of the invention according to the first aspect, the material to be stamped can be stamped by the optimum speed and applying predssure corresponding to the difference of the weight of the stamping means or the contact position with the processing surface.

[0043] According to the invention of the third aspect or the sixth aspect, in addition to the effect of the invention according to the first or fifth aspect, because the user can quickly recognize that the stamping means is at a position at which the stamping onto the material to be stamped can not be conducted, the time or power consumption can be saved.

[0044] According to the invention of the fourth aspect, in addition to the effect of the invention according to the first aspect, by keeping the torque applied onto the driving means constant, the stamping can be conducted with the uniform depth without depending on the contact position of the stamping section with the processing surface.

## Claims

### 1. A stamping apparatus, comprising:

stamping means for stamping onto a processing surface of a material to be stamped by reciprocally moving a stamping section;  
stamping section moving means for moving the stamping section in two-dimensional direction to the processing surface; and  
applying pressure adjustment means for causing the stamping section to maintain a predetermined pressure onto the processing surface;

wherein the stamping means is provided with a cam apparatus to reciprocally move the stamping section linearly when it is driven by the cam rotated by driving means.

5

2. The stamping apparatus according to Claim 1, further comprising: contact detection means for detecting the contact of the stamping section with the processing surface by the change of a current value flowing through the driving means, and the applying pressure adjustment means adjusts the pressure onto the processing surface according to the detection result, when the contact of the stamping section with the processing surface is detected by the contact detection means. 10 15
3. The stamping apparatus according to Claim 1, wherein the apparatus further has an alarming means for outputting the alarm, when it is detected that the stamping section does not contact with the processing surface by the contact detection means, in the case of reciprocating movement of the stamping section by the stamping means. 20
4. The stamping apparatus according to Claim 1, wherein the apparatus has a cam with a cam curve by which the torque applied onto the driving means by the contact of the stamping section with the processing surface becomes constant without depending on the contact position with the processing surface. 25 30
5. A stamping method comprising the steps of:
  - reciprocally moving the stamping section linearly when it is driven by the cam rotated by a driving means; 35
  - moving the stamping section in two-dimensional direction to the processing surface; a contact detection process to detect the contact of the stamping section with the processing surface by the change of a current value flowing through the driving means; and 40
  - causing the stamping section to maintain a predetermined pressure onto the processing surface, according to the detection result, when the contact of the stamping section with the processing surface is detected by the contact detection process. 45 50
6. The stamping method according to Claim 5, further comprising the steps of: outputting the alarm, when it is detected that the stamping section does not contact with the processing surface by the contact detection process, in the case of reciprocating movement of the stamping section in the stamping process. 55

図面

FIG. 1

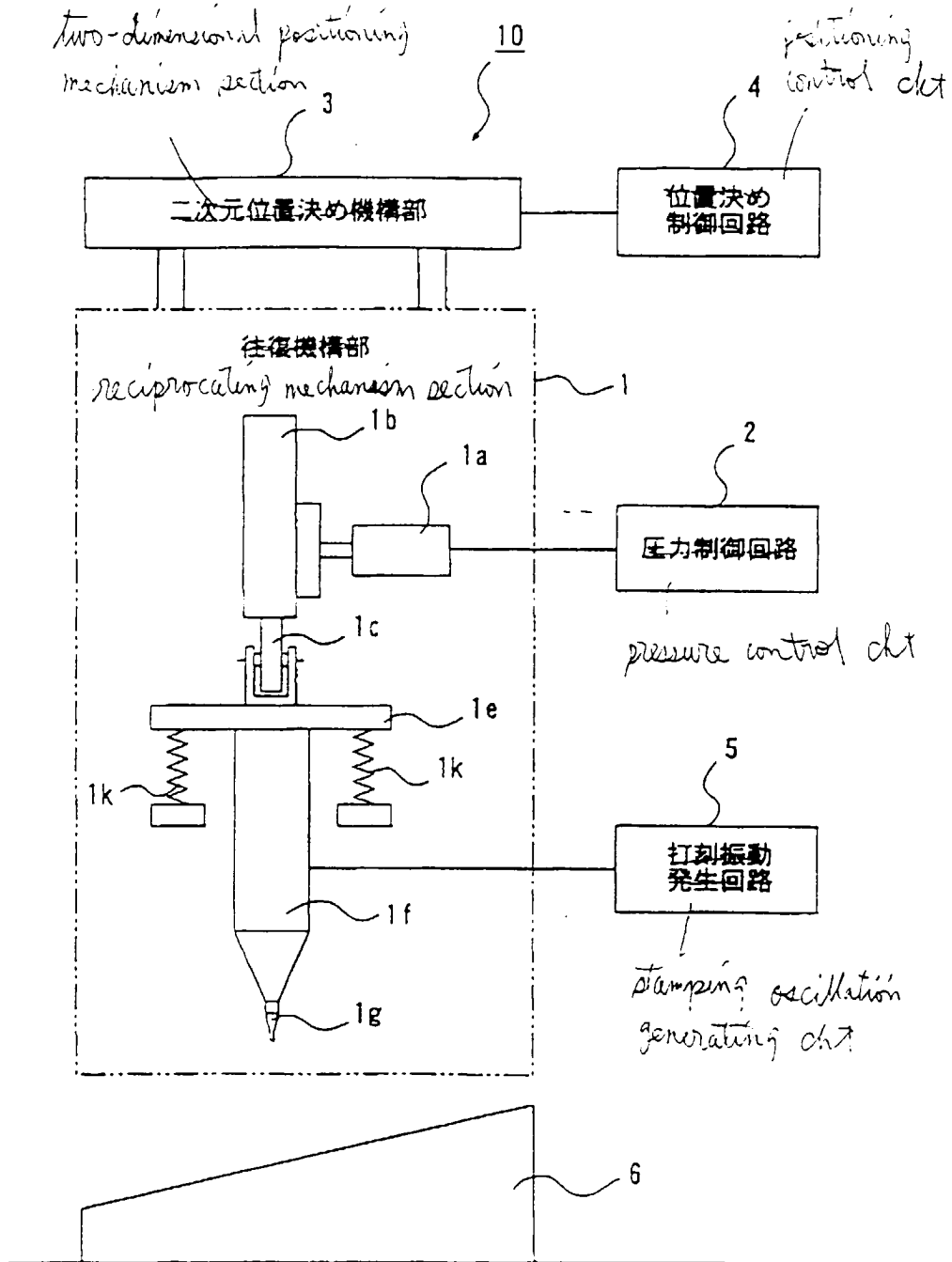


FIG. 2

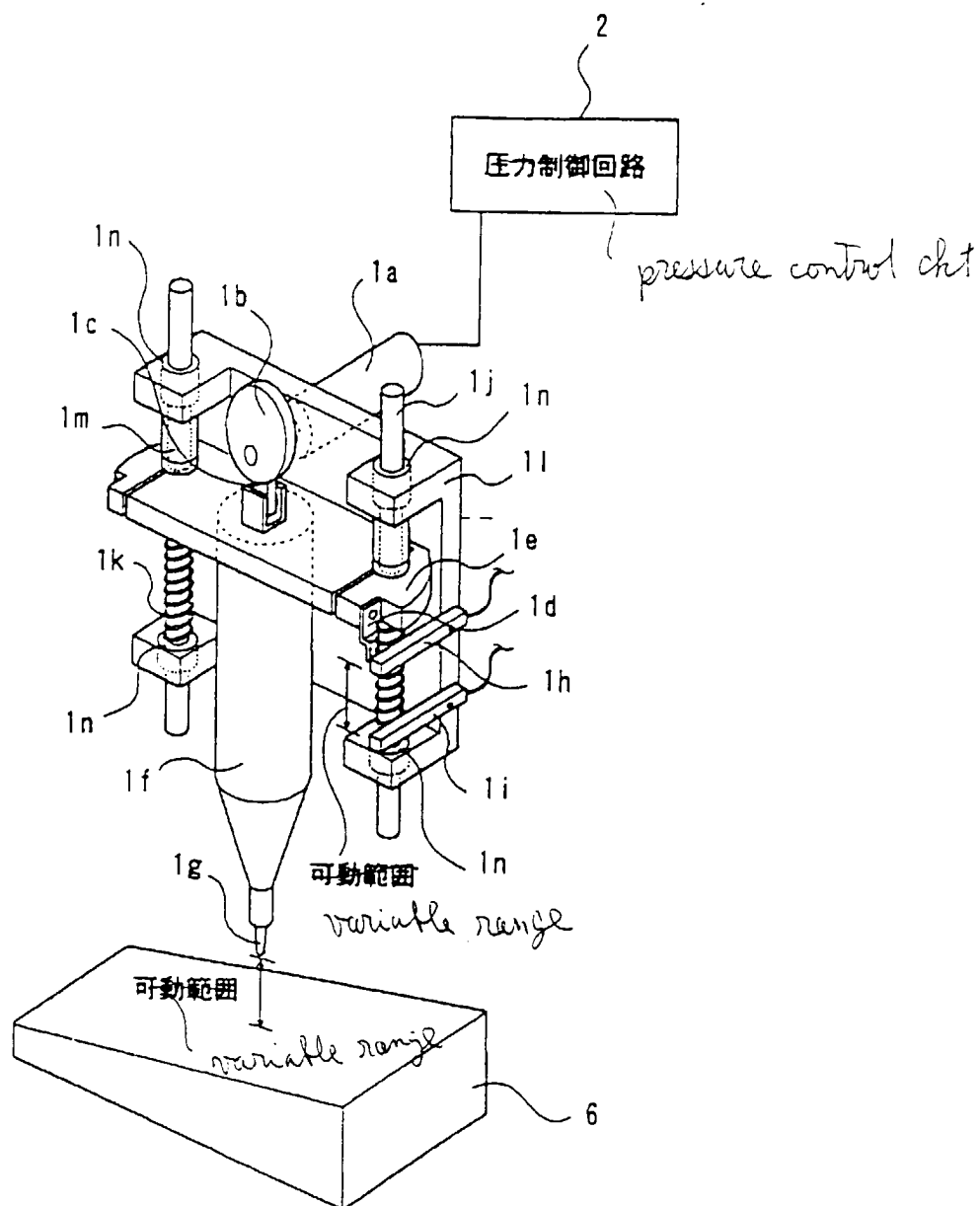




FIG. 3

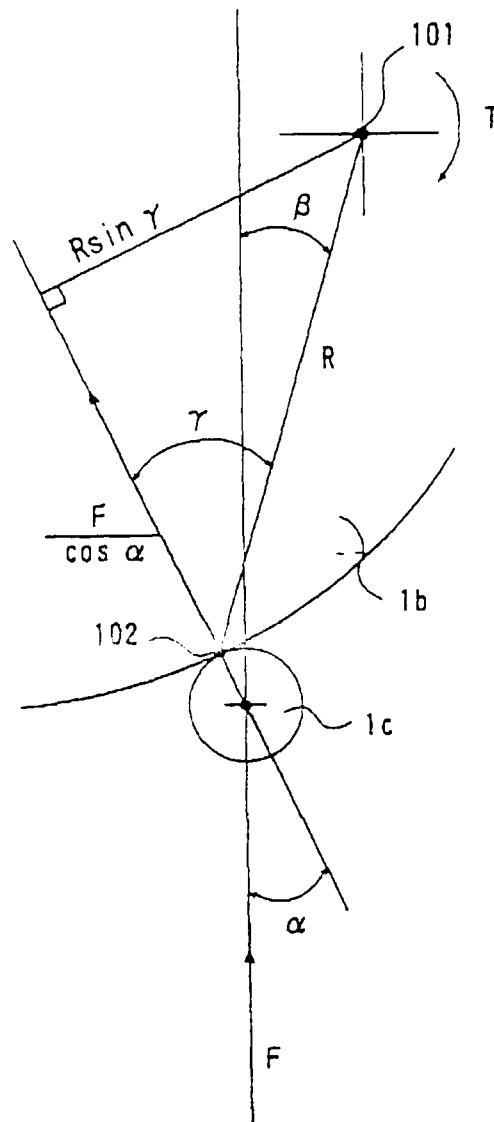


FIG. 4

