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

(11) EP 1 304 179 A1

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**23.04.2003 Bulletin 2003/17**

(51) Int Cl.[7]: **B21D 37/20**

(21) Application number: **02023622.0**

(22) Date of filing: **18.10.2002**

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

(30) Priority: **19.10.2001 JP 2001322565**

(71) Applicant: **Ricoh Company, Ltd.**
**Tokyo 143-8555 (JP)**

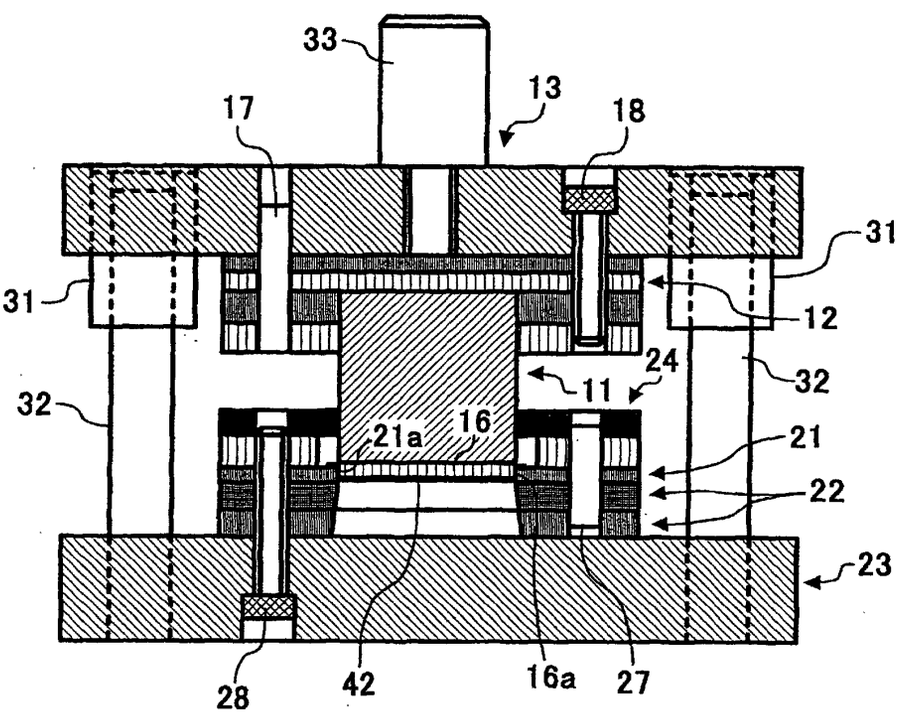
(72) Inventors:
- **Kurihara, Hirokazu**
  **Ohta-ku, Tokyo 143-8555 (JP)**
- **Tanaka, Tomio**
  **Ohta-ku, Tokyo 143-8555 (JP)**
- **Yamamuro, Seiichi**
  **Ohta-ku, Tokyo 143-8555 (JP)**

(74) Representative: **Schwabe - Sandmair - Marx**
**Stuntzstrasse 16**
**81677 München (DE)**

## (54) Metal mold for press working

(57) Disclosed is a metal mold for press working which is highly durable and which can be manufactured inexpensively in a shorter time. Although the metal mold for press working is constructed by laminating a plurality of steel sheets cut by laser beam, at least a punch and a die are constructed with high-carbon steel sheets cut by laser beam. The cutting is achieved by laser beam having a thin leading end thereof for example. The punch (11) and the die (21) employ an exit side of the laser beam as a cutting edge.

FIG. 1




EP 1 304 179 A1

## Description

### BACKGROUND OF THE INVENTION

#### Field of the Invention

**[0001]** The present invention relates to a metal mold for press working, and more specifically to an improvement of a metal mold for press working in which steel sheets cut by laser beam are laminated.

#### Description of the Prior Art

**[0002]** A conventional metal mold for press working is manufactured by rendering blocks of a steel material to effect cutting, polishing, and a heat treatment, and so on, so that it suffers from a great number of processes of machining followed by an increased time interval up to its finishing, and from the high cost thereof. Further, the prior art suffers from a difficulty that when modification happens upon trial processing after a mold is manufactured, a punch and a die must be re-processed, which requires considerable time until re-trial processing.

**[0003]** Japanese Laid-Open Patent Publication No. 5-53735 discloses a metal mold for press working which can be manufactured inexpensively by cutting a steel sheet with laser beam and laminating resulting cut steel sheets.

**[0004]** Further, Japanese Laid-Open Patent Publication No. 2-229630 discloses a metal mold for press working wherein although a punch and a die are formed by laminating steel sheets cut with laser beam, only a cutting edge is manufactured with a wire cutting method.

**[0005]** However, although the mold for press working disclosed in the Japanese Laid-Open Patent Publication No. 5-53735 can be manufactured inexpensively, a steel sheet constituting a lamination plate is thin, and does not allow hardening to result in low durability. Further, the mold for press working disclosed in the Japanese Laid-Open Patent Publication No. 2-229630 inevitably permits a prolonged interval of the manufacture thereof to result in the high cost because the cutting edges for a punch and a die must be manufactured separately.

### SUMMARY OF THE INVENTION

**[0006]** In view of the drawbacks with the prior art, it is an object of the present invention to provide a mold for press working which is highly durable, and manufactured inexpensively in a shorter time.

**[0007]** To achieve the above object, according to a first aspect of the present invention, a mold for press working is constructed with high-carbon steel sheets , in which mold a punch and a die are cut by laser beam.

**[0008]** To achieve the above object, according to a second aspect of the present invention, a mold for press working is constructed with high-carbon steel sheets cut by laser beam, and at least one of a die and a punch is formed with a laminate of high-carbon steel sheets cut by penetrating the high-carbon steel sheets with laser beam having its tapered end in a direction of the thickness of the sheets and moving the laser beam perpendicularly to the direction of the thickness of the sheets, and further use is made as a cutting edge of a laser beam exit side of the cut high-carbon steel sheets in the direction of the sheet thickness of the same.

**[0009]** A mold for press working according to the present invention has the roughness of the cut surface ranging from 10 to 20 μm in a mold for press working according to claim 2.

**[0010]** According to a third aspect of the present invention, a mold for press working is provided wherein a punch and a die are formed with high-carbon steel sheets cut by laser beam, and the die and the punch are formed by penetrating the high-carbon steel sheets with laser beam having a thin leading end and obtained by selecting at least laser beam intensity , a cut speed, an assist gas injection speed in a direction of thickness of the high-carbon steel sheets, and by laminating the high-carbon steel sheets cut by moving the laser beam perpendicularly to the direction of the thickness of the sheets, and further a laser beam exit side of the cut high-carbon steel sheets is employed as a cutting edge.

**[0011]** According to a fourth aspect of the present invention, a mold for press working is provided wherein a work is bent with a punch equipped with a wedge for plastically deforming a work upon bending processing, and the wedge is provided on a wedge plate assembled detachably on the punch.

**[0012]** According to a fifth aspect of the present invention, a mold for press working is provided wherein a work is bent with a die including a die radius for preventing any abnormal recess and a defect from being formed on the work, the die radii being disposed detachably on the die and provided on the die radius plate.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0013]**

Fig. 1 is a cross sectional view illustrating one preferred embodiment of a mold for press working according to the present invention constructed as an external blanking mold;

Fig. 2 is a view illustrating a work formed by the mold for press working illustrated in Fig. 1;

Fig. 3 is a decomposed perspective view of the mold for press working illustrated in Fig. 1;

Fig. 4 is a view illustrating a manufacturing process for a punch and a die of the mold for press working illustrated in Fig. 1;

Fig. 5 is an enlarged cross sectional view of the punch in the mold for press working in Fig. 1;

Fig. 6 is an enlarged cross sectional view of a die in the press working die illustrated in Fig. 1;

Fig. 7 is an enlarged cross sectional view taken along a line A-A in Fig. 5;

Fig. 8 is a cross sectional view illustrating a preferred embodiment of a mold for press working according to the present invention constructed as a bending mold;

Fig. 9 is a view of a work molded with the bending mold illustrated in Fig. 8;

Fig. 10 is a view illustrating the construction of the bending mold illustrated in Fig. 8; and

Fig. 11 is a perspective view of a punch plate and a die plate assembled in the bending mold illustrated in Fig. 8.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0014]** Referring to Figs. 1 to 7 a mold for press working according to the present invention constructed as an external blanking mold is illustrated.

**[0015]** Such a blanking mold is to blank a rectangular blank 42 from a work 41 comprising a metal stripe. The blanking mold comprises in itself an upper mold including a punch 11, a punch plate 11, and a punch holder 13, and a lower mold including a die 21, a die plate 22, a die holder 23, and a stripper 24, as illustrated in Fig. 1.

**[0016]** The punch 11 comprises a laminate of a body member 15 and a cutting edge member 16, as illustrated in Fig. 3. The cutting edge 16a is formed on a side surface of the cutting edge member 16. The die 21 comprises a sheet of plate. There is formed a hole in the die 21 at the center of the same, to which hole the punch 11 is fitted. The cutting edge 21a is formed with the side surface of the hole.

**[0017]** The cutting edge member 16 of the punch 11 and the die 21 are manufactured by cutting with laser beam a high-carbon steel sheet, e.g., carbon tool steel containing carbon of 0.6 to 0.7 %.

**[0018]** Referring now to Fig. 4, a cut state by the laser beam 51 is illustrated. Parallel light 50 is converted to focused laser beam 51 having a thin leading end thereof through a focusing lens 50'. The cutting is achieved by penetrating the laser beam 51 through at least one high-carbon steel sheet 52 in a direction of the thickness thereof while injecting assist gas such as nitrogen and oxygen thereto.

**[0019]** Referring further to Fig. 4, the focused laser beam 51 cuts the high-carbon steel sheet 52 , wider on an incident side 52a but narrower on an exit side 52b. A cut surface 53 of the cut high-carbon steel sheet 52 is inclined at an angle corresponding to the focused laser beam 51. As illustrated in Fig. 6, the punch 11 is formed by laminating the cut edge member 16 which is formed as described above, on the punch body 15. The thickness of the steel sheet 52 is not particularly limited. Processing time for a thin steel sheet is short, so that many thin steel sheets can be manufactured, but many steel sheets must be laminated, while much time is required for cutting a thick steel sheet, and a cut surface is likely to be uneven. For this, the thickness of a steel sheet is selected taking required accuracy and processing time into consideration.

**[0020]** The die 21 is also manufactured by cutting a steel sheet with the focused laser beam 51. More specifically, a high-carbon steel sheet is cut into a predetermined size with the focused laser beam 51, and an opening to which the punch is fitted is also formed with the laser beam. A side surface or a cut surface where the opening is formed forms a cut edge 21a, which edge is inclined at an angle corresponding to the focused laser beam .

**[0021]** Such a cut surface 53 is obtained by selecting conditions such as laser beam intensity, a cut speed, and an assist gas injection speed. The steel sheet 52 is heated and quenched with the laser beam 51 and the assist gas upon its being cut, so that the cut surface 53 of the high-carbon steel sheet that forms the cut edge member 16 and the cutting edges 16a, 21a of the die 21 are heat treated, and hardened. The thickness H1 of a hardened layer indicated by a reference symbol H in Fig. 4 on the exit side 52b of the focused laser beam 51 in the direction of the sheet thickness becomes deeper than that on the incident side 52a owing to thermal conduction in the steel sheet upon cutting and owing to the assist gas. A linear molten trace is formed in the cut surface 53 in the thickness direction, which cut surface 53 is configured into a saw-tooth as illustrated in Fig. 7.

**[0022]** The punch plate 12 and the punch holder 13 comprise a plurality of plates, respectively. The die plate 22, the die holder 23, and the stripper 24 also comprise a plurality of plates, respectively. These members are manufactured by cutting a general structure rolled steel sheet with laser beam.

**[0023]** Referring to Fig. 1, the upper mold is constructed by placing the punch 11 on the punch holder 13 together with the punch plate 12, driving a positioning pin or a knock pin 17, and tightening a bolt 18 for them. The lower mold is constructed by anchoring the die 21 to the die plate 22 and the die holder 23, disposing the stripper 24 at an upper portion thereof, driving a positioning pin or a knock pin 27, and tightening a bolt for them.

**[0024]** The upper mold and the lower mold are coupled by inserting a guide bush 31 of the upper mold into a guide post 32 of the lower mold. The blanking die is mounted on a press machine by anchoring a shank 33 of the upper mold to a ram, and the die holder 23 of the lower mold to a table, and so on.

**[0025]** The press working is achieved by disposing a metal stripe that is a work 41 in a space 24' located between the stripper 24 and the die 21, and elevating the upper mold 10. A blank 42 as illustrated in FIG. 2 is obtained by horizontally moving the work 41 for each elevation. Herein, the hardened layers of the cutting edge 16a of the cut edge member 16 of the punch 11 and the cutting edge 21a of the die 21 are deeper on the side thereof where they make contact with the work 41 than

that on the opposite side, and the surface 11a and the cutting edge surface 21a have a molten trace extending in the thickness direction thereof and are configured into a saw-toothed shape to not only ensure excellent blanking but also an advantage where blanking debris are prevented from returning to a punch side to secure escaping of such debris. Surface roughness of the cut surface 53 of the cutting edge 16a and the cutting edge 21a ranging from 10 to 20 μm provides a more excellent result.

**[0026]** The metal mold for press working according to the present invention can reduce time and the number of processes required for a heat treatment and a hardening processing because the cutting edge member 16 of the punch 11 and the cutting edge 21a of the die 21 are hardened without being subjected to a particular hardening processing. The metal mold for press working does not require modification because there is no deformation such as warp which is likely to occur upon a heat treatment for a steel sheet and the like. Processing time, heat treatment time, and modification time required for manufacturing a metal mold can therefore be reduced, and hence the metal mold for press working can be manufactured inexpensively in a short time.

**[0027]** Referring subsequently to Figs. 8 to 11, another preferred embodiment of the metal mold for press working according to the present invention is illustrated.

**[0028]** The present metal mold for press working is constructed as a bending mold for the purpose of obtaining a U-shaped work-piece 142 by bending into U-shape a work 141 obtained by blanking a metal stripe into a rectangular configuration as illustrated in Fig. 9.

**[0029]** The bending mold comprises an upper mold and a lower mold as illustrated ion Fig. 8. The upper mold includes a punch 111, a punch plate 112, and a punch holder 113. The lower mold includes a die 121, a die plate 122, a die holder 123, and a stripper 124.

**[0030]** The punch 111 and the punch plate 112 comprise a laminate obtained by cutting a steel sheet with laser beam and laminating a plurality of the cut steel sheets. The die 121 comprises a sheet of steel sheet and is manufactured by cutting the steel sheet with laser beam. The die plate 122 comprises a laser processed steel sheet. The punch 111 and the die 121 comprise high-carbon steel sheet such as carbon tool steel, and the punch plate 112 and the die plate 122 comprise a general structure steel sheet.

**[0031]** The upper mold is constructed by threading the punch 111, the punch plate 112 with a screw 115, laminating the just-mentioned members on the punch plate 112 and the punch holder 113, driving a positioning pin or a knock pin 117, and tightening a bolt 118 for them. The lower mold is constructed by laminating the die 121 trough die plate 122 on the die holder 123, driving a positioning pin or the knock pin 127, and tightening them with a bolt 128. A knockout 129 is disposed in openings of the die 121 and the die holder 123 and is supported by the coiled spring 129'. Further, as illustrated in Fig. 10, a kicker pin 125 is fitted to a lower surface of the punch 111.

**[0032]** Further, in the present bending mold, the wedge plate 116 is disposed on the side surface of the punch 111, and a die radius plate 123 is disposed on the die holder 123.

**[0033]** The wedge plate116 is constructed by bending into an L-shape a metal sheet with high hardness of a high-carbon steel sheet such as stainless steel sheet or carbon tool steel. The wedge plate 116, as illustrated in Fig. 10, is adapted such that an end 116a of one piece thereof is protruded from the lower surface of the punch 111 and is brought into contact with both side surfaces of the punch 111, and the other piece thereof is brought into contact with the lower surface of the punch plate 112, positioned by the plate holder 119, and is put between the plates 112 and 119. Once the wedge plate 116 is put between the plates 112 and 119, the end 116a of the wedge plate 116 is protruded from the lower surface of the punch 111 to form a proper length step S.

**[0034]** The die radius plate 126 is also constructed by bending into L- shape a hard metal sheet of a high-carbon steel sheet such as stainless and carbon tool steel. A die radius 126b is formed on a shoulder of the die radius plate 126. In the die radius plate 126, the die radius126b is positioned on the shoulder of the die 121, i.e., positioned across the opening edge of the die 121, and the die radius 126b is directed outside with its one piece disposed on the upper surface of the die and fixed to the same and with the other piece disposed among the die 121, the die plate 122, and the knockout 129 and fixed to the die 121.

**[0035]** The coupling of the upper mold and the lower mold is achieved by inserting a guide bush 131 of the upper mold into a guide post 132 of the lower mold, as illustrated in Fig. 8. These molds are mounted on a press machine by fixing a shank 133 to a ram and the die plate 123 to a table and the like. In the bending mold the punch holder 113, the plate holder 119, stripper 124, and die holder are manufactured by cutting a steel sheet with laser beam.

**[0036]** The press working is achieved by disposing the work 141 in a space 124' located between the die 121 and the stripper 124., and elevating the upper mold. When the upper mold is moved toward the lower mold, the kicker pin 125 pushes the work 141, and then the wedge plate 116 subjects the work 141 to plastic deformation and U bending the same while preventing the wedge plate 116, and the die radius plate 126 forms a bend radius on the work 141. As the upper mold further advances, U bend article 142 is molded as illustrated in Fig. 8. Thereupon, although the knockout 129 is lowered while compressing the spring 129' following the lowering of the upper mold, once the upper mold is returned, the knockout 129 is raised with the aid of the spring 129' to push a molded article up from the die 121.

**[0037]** In the bending mold, alteration of a step S of the wedge plate 116 and the punch 111 is achieved by

exchanging the wedge plate 116 by another wedge plate 116. More specifically, the alteration of the step S is achieved by preparing a wedge plate 116 where the bend position 116b is changed and the height of a piece thereof having the end 116a is changed. An adjustment of the width of the die radius 126b or the size of the radius is achieved by preparing a wedge plate where plate thickness thereof is altered and bent, and exchanging it. An adjustment of the size of a shoulder radius of the die radius plate 126 is achieved by preparing a die radius plate where the size of the radius at an inside corner corresponding to the die radius 126b is changed, and exchanging it.

**[0038]** Also in the mold for press working, the cost of equipment for manufacturing a mold is low with processing time reduced, and hence a metal mold is obtained in a short time inexpensively because the punch 111, punch plate 112, punch holder 113, die 121, die plate 122, die holder 123, and stripper 124 are manufactured only by a processing machine using laser beam.

**[0039]** Since the wedge plate 116 is independent from the die 121, the alteration of the step S of the wedge plate 116 and the punch 111 is achieved by the exchange of the wedge plate 116. More specifically, in prior art, a wedge is provided at the root of the bend section of the punch to prevent the spring back in order to ensure bend angle accuracy. The wedge is formed on part of the punch as a protrusion, and accuracy of the angle and width of a bent processed article is changed by adjusting the height and width of the protrusion. The wedge is formed by cutting processing and polishing processing. In the bending mold according to the present invention the alteration of the step S of the wedge plate and the punch 111 is achieved by simply exchanging only the wedge plate 116 or by modifying only the wedge plate 116. More specifically, since the wedge is obtained, the adjustment is achieved in a short time inexpensively, and the wedge plate itself is also manufactured inexpensively only by rendering a sheet material easy in processing to bending processing.

**[0040]** Further, alteration of the die radius 126b is realized by the exchange of the die radius plate 126. More specifically, the die radius is provided on the die in order for that upon the bending processing a work is smoothly taken in the die to prevent any abnormal recess and flaw from occurring in the work. The size and the configuration of the die radius can not be calculated so that they are confirmed with trial bending processing. In prior art, an adjustment of the die radius is carried out by demounting the die from the lower mold and cutting and polishing the die, and mounting the die on the lower mold, and further bending the die in trial. However, in the bending mold according to the present invention the alteration of the die radius 126b, and also the alteration of a material quality and plate thickness of the work are achieved only by the exchange of the die radius plate 126, so that the adjustment is simplified with the low cost. The die radius plate itself can also be manufactured only by rendering a plate material easy in processing inexpensively to the bending processing .

**[0041]** Although in the embodiment described above, the die plates 21, 121 comprise one sheet of laser processed steel, they may be constructed with a laminate of a plurality of steel sheets laser processed in response to blanking or bending conditions. Although in the bending mold, the wedge plate 116 and the die radius plate 126 are constructed by the bending processing of a sheet material, and the punch 111, punch plate 112, punch holder 113, die 121, die plate 122, die holder 123, stripper 124, etc., are constructed with a laminate obtained by cutting a steel sheet by laser beam to manufacture the bending mold inexpensively, the adjustment is achieved in a short time inexpensively even when the wedge plate 116 and the die radius plate 126 are assembled in a punch and a die manufactured by processing a prior art metal block.

**[0042]** In accordance with the present invention there is eliminated the need of a process for hardening a punch and a die, so that an inexpensive metal mold for press working is obtained in a short time for manufacturing.

**[0043]** Since cutting edges of a punch and a die are formed simultaneously with the cutting thereof, an inexpensive metal mold for press working is obtained in a short time for manufacturing.

**[0044]** Further, there is ensured a metal mold for a punch and a die excellent in durability with the satisfactory cutting quality.

**[0045]** Since a wedge plate that plastically deforms a work upon bending processing can be demounted from the punch, modification is achieved in a short time with ease , so that there is ensured a metal mold, which can be returned easily in a short time even when the metal mold wears owing to trial adjusting and bending processing.

**[0046]** Furthermore, since a die radius plate for preventing spring back of a work can be demounted from a die , the modification can be achieved easily in a short time, so that there is ensured a metal mold for press working capable of exchange with ease in a short time even when the metal mold wears owing to trial adjustment processing and bending processing.

## Claims

1. A metal mold for press working, **characterized in that** it includes a punch and a die, and that said punch and die comprise a high-carbon steel sheet and are formed by cutting the high-carbon steel sheet with laser beam.

2. A metal mold for press working constructed by laminating a plurality of steel sheets cut by laser beam, **characterized in that** at least one of a die and a punch is formed from a laminate of cut high-carbon

steel sheets cut by penetrating the high-carbon steel sheets in a direction of thickness of the same with focused laser beam and moving the laser beam perpendicularly to the direction of the thickness of the high-carbon steel sheets, and **in that** a laser beam exit side of the cut high-carbon steel sheets in the direction of the thickness of the same is employed as a cutting edge.

**3.** A metal mold for press working according to claim 2, **characterized in that** the roughness of the cut surface of said high-carbon steel sheets ranges from 10 to 20μm.

**4.** A metal mold for press working constructed with a plurality of steel sheets cut by focused laser beam, **characterized in that** a die and a punch are constructed with laminated high-carbon steel sheets cut by penetrating the high-carbon steel sheets in the direction of the thickness of the same with laser beam having its tapered end and obtained by selecting at least laser beam intensity, a cutting speed, and an assist gas injection speed, and moving the laser beam perpendicularly to a direction of the thickness of the high-carbon steel sheet, and a laser beam exit side in the direction of the thickness of the cut high-carbon steel sheets is employed as a cutting edge.

**5.** A metal mold for press working in which a work is bent with a punch equipped with a wedge for plastically deforming the work upon bending processing, **characterized in that** the wedge is provided on the wedge plate assembled detachably in the punch.

**6.** A metal mold for press working in which a work is bent with a die having a die radius for preventing any abnormal recess and any fault from occurring in the work , **characterized in that** said die radius is detachably disposed and is provided on a die radius plate.

FIG. 1

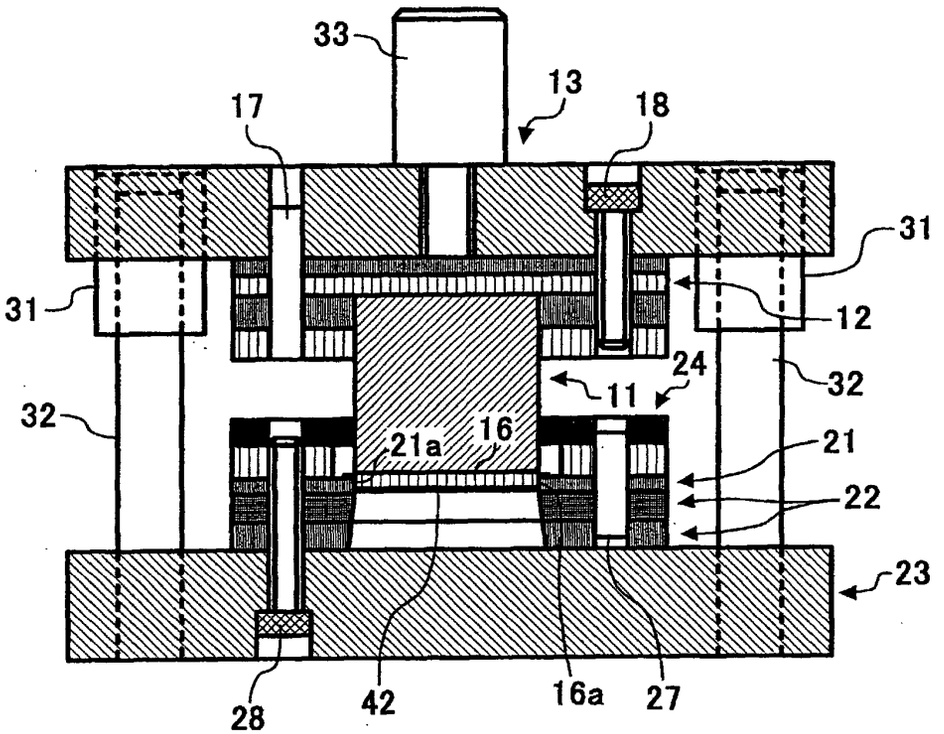



FIG. 2

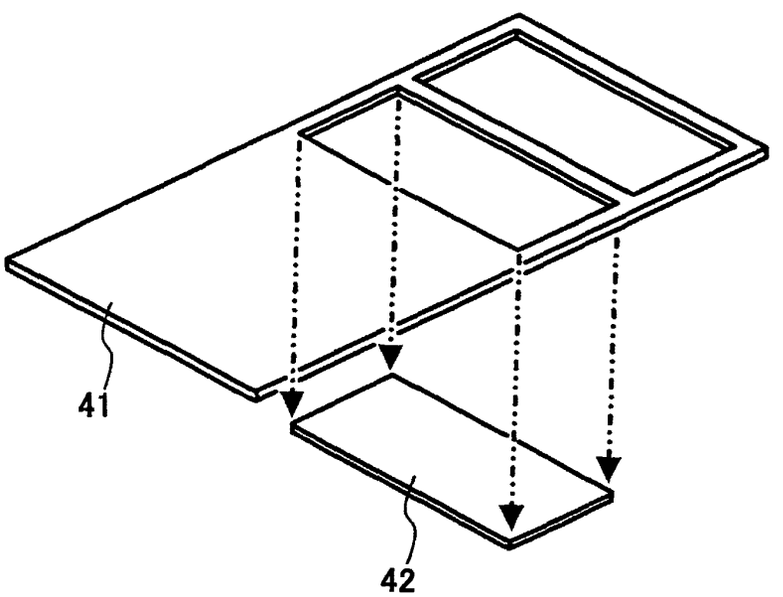


FIG. 3

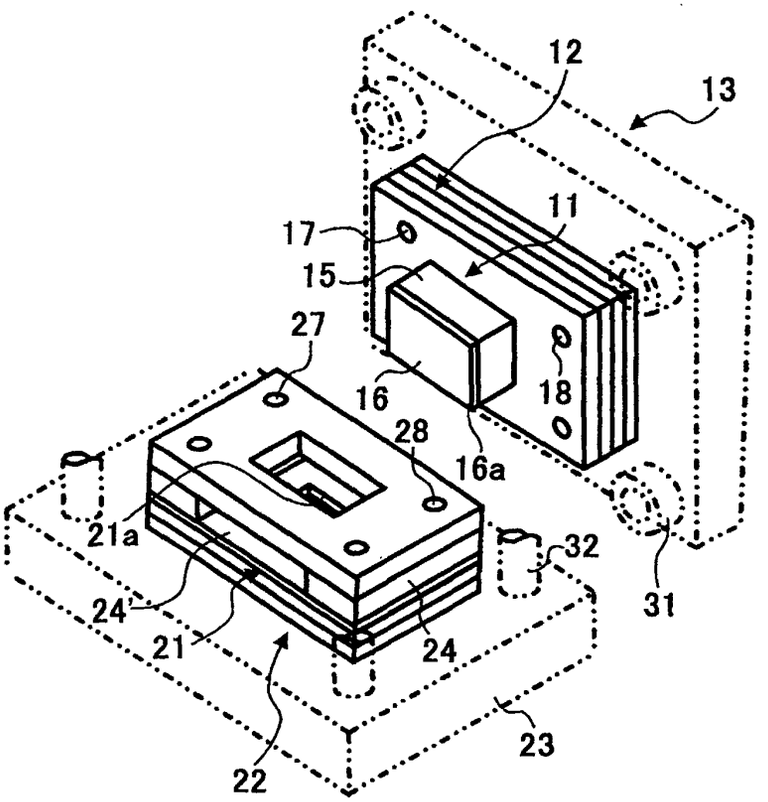

12
13
11
17
15
27
16
18
28
16a
21a
32
31
24'
21
24
22
23

FIG. 4

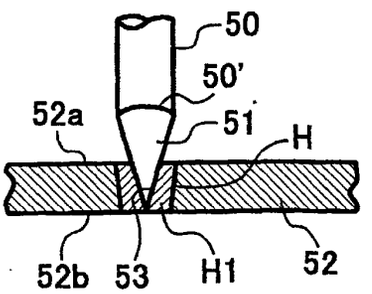

50
50'
52a
51
H
52b
53
H1
52

FIG. 5

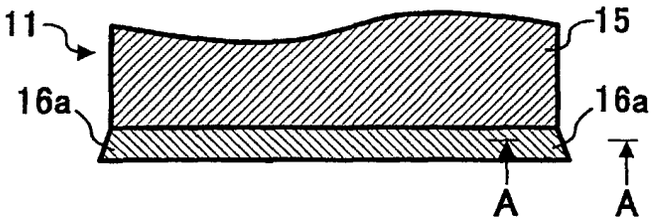



FIG. 6

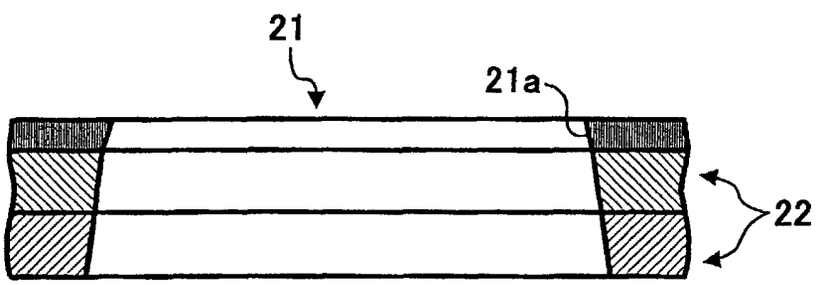



FIG. 7

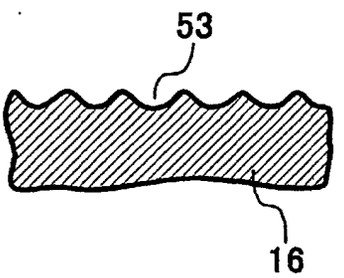


FIG. 8

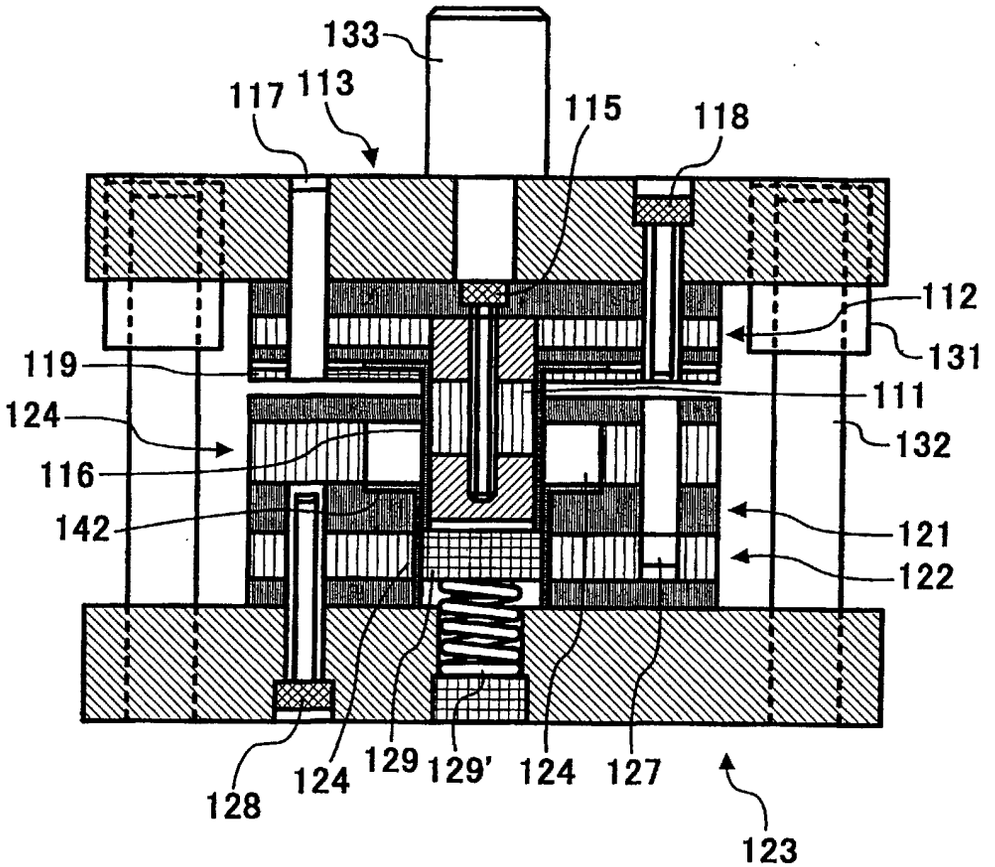

133
117
113
115
118
112
131
119
111
124
132
116
142
121
122
128
124
129
129'
124
127
123

FIG. 9

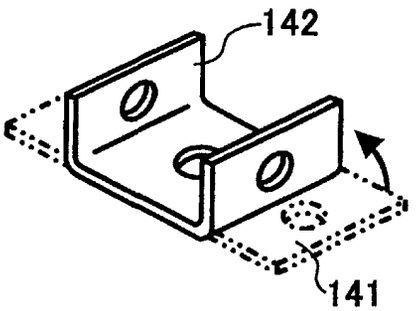

142
141

FIG. 10

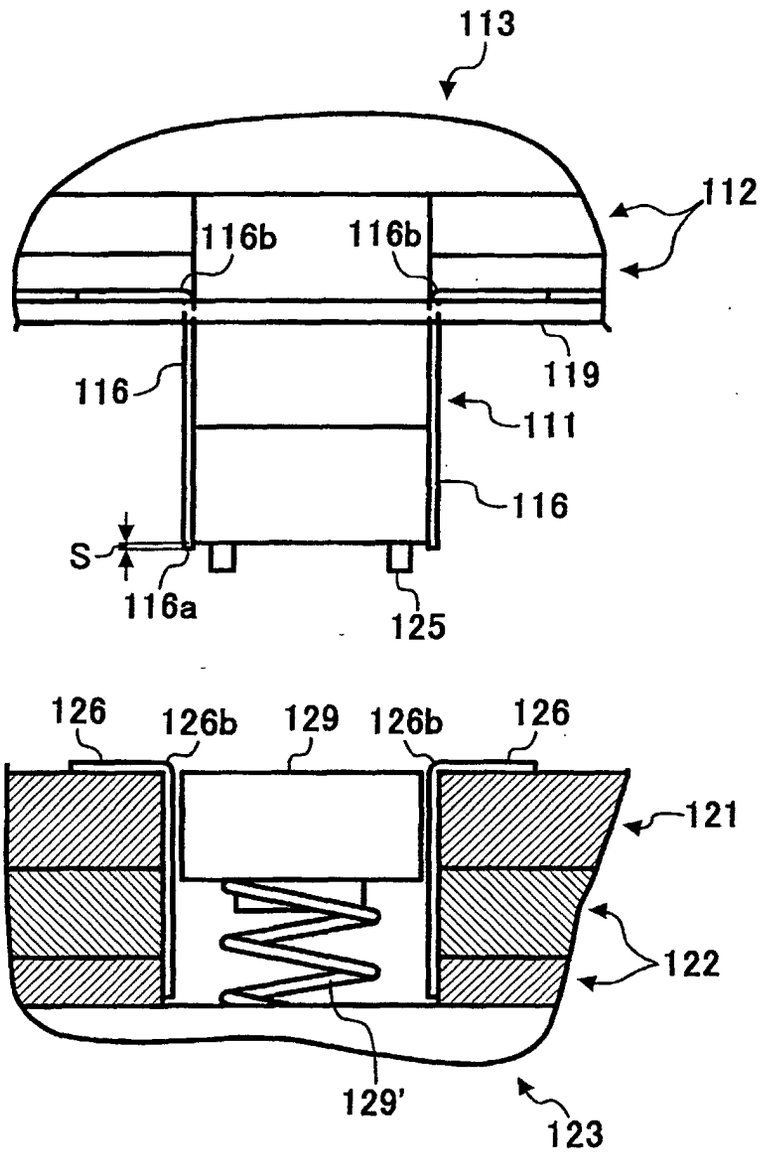
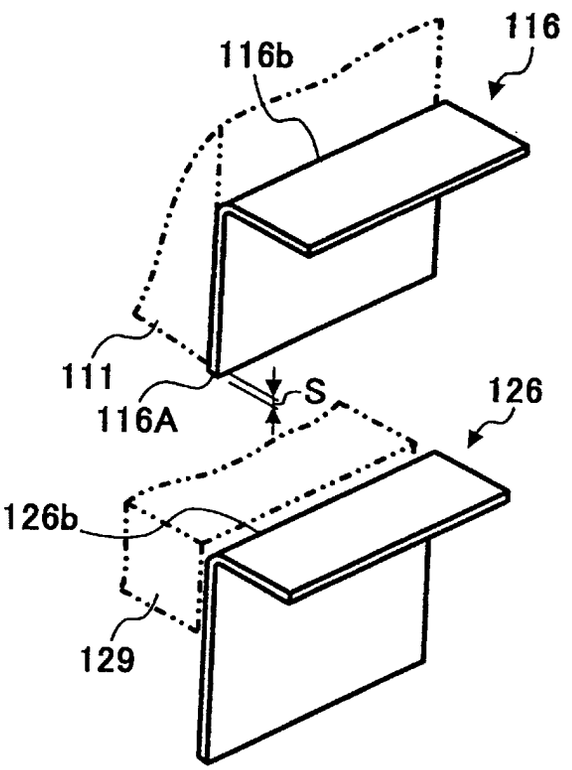

113
112
116b
116b
119
116
111
116
S
116a
125
126
126b
129
126b
126
121
122
129'
123

FIG. 11



European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 02 02 3622

## 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.7) |
|---|---|---|---|
| X | PATENT ABSTRACTS OF JAPAN<br>vol. 008, no. 249 (M-338),<br>15 November 1984 (1984-11-15)<br>& JP 59 125288 A (KONISHIROKU SHASHIN KOGYO KK), 19 July 1984 (1984-07-19) | 1,2,5,6 | B21D37/20 |
| A | * abstract * | 4 | |
| A | PATENT ABSTRACTS OF JAPAN<br>vol. 005, no. 039 (M-059),<br>14 March 1981 (1981-03-14)<br>& JP 55 165239 A (NAKAGAWA TAKEO;OTHERS: 01), 23 December 1980 (1980-12-23)<br>* abstract * | | |
| A | PATENT ABSTRACTS OF JAPAN<br>vol. 009, no. 252 (M-420),<br>9 October 1985 (1985-10-09)<br>& JP 60 102234 A (MITSUBISHI DENKI KK),<br>6 June 1985 (1985-06-06)<br>* abstract * | | TECHNICAL FIELDS SEARCHED (Int.Cl.7)<br>B21D |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 24 January 2003 | Peeters, L |

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 (P04C01)

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 02 3622

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

24-01-2003

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| JP 59125288 A | 19-07-1984 | NONE | |
| JP 55165239 A | 23-12-1980 | NONE | |
| JP 60102234 A | 06-06-1985 | NONE | |