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(54) **Manufacture method for magnesium alloy product**

(57) A manufacture method for a magnesium alloy product includes steps of: providing a mold comprising an upper mold and a lower mold, the upper mold having a punch, the lower mold having a cavity, the punch being adapted to be accommodated in the cavity; heating the mold so as to increase the temperature of the cavity to a determined degree; placing a magnesium alloy billet in the heated cavity; and compressing the upper and lower molds so as to drive the punch to deform the magnesium alloy billet to a magnesium alloy product having a shape corresponding to the cavity. The punch in the cavity and an inner wall of the cavity are configured to have a gap of 0.05mm~0.1mm.

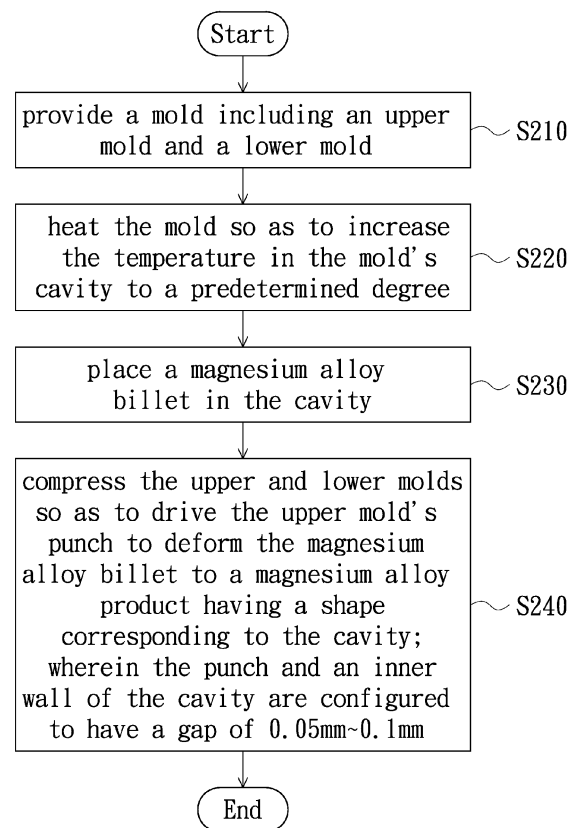


FIG. 2

Description

TECHNICAL FIELD

[0001] The present invention relates to a manufacture method for a metal product, and more particularly to a manufacture method for a magnesium alloy product.

BACKGROUND

[0002] Generally, metal materials are, compared to the plastic materials, heavier but with a higher strength. However, by using some alloys, such as the aluminum, magnesium or titanium alloys, alloy products can have features of lightweight and high strength both. Specifically, magnesium alloy has some advantages, such as a light weight, good heat dissipation, anti-electromagnetic interference, high hardness and high plasticity. Thus, the magnesium alloy has been widely used in some industries.

[0003] Magnesium alloy processing, especially in the housing or case industries, has a large potential in market; and accordingly a variety of key processing technologies are being developed by many manufacturers. In general, the magnesium alloy molding technologies can be categorized to die casting, semi-solid forming, forging and stamping. Today, most of the magnesium alloy products are manufactured by die casting. However, the magnesium alloy products manufactured by die-casting process basically may have some disadvantages, such as having a higher defective ratio if the thickness thereof is relatively thin, as well as the thermal cracking, oxidation, rhyolite, insufficient strength and unexpected deformation issues. Thus, labor-consuming refurbishments are consequently resulted in and thereby increasing the cost.

[0004] To the stamping process, magnesium alloy can only have partial deformation and partial edge deletion and cannot have a specific cross-sectional deformation. In other words, the magnesium alloy cannot be deformed to have a fastening component directly by the stamping process, and have to be equipped with plastic components or other types of component.

[0005] Compared to the stamping process, forging process allows the magnesium alloy billet can have a significant deformation to form an expected cross section. In addition, the produced magnesium alloy product can have a smooth surface, so that the subsequent surface process is relatively simple. Therefore, it is worth to keep developing the forging process.

[0006] FIG. 1A is a schematic cross-sectional view of a conventional mold for a hot-forging process. FIG. 1B is a schematic cross-sectional view of a magnesium alloy product manufactured by the mold shown in FIG. 1A. Referring to FIGS. 1A, 1B, the mold 100 includes an upper mold 102 and a lower mold 104. In the conventional forging process, firstly a magnesium alloy billet 106 is placed in a cavity 105 of the lower mold 104, and the upper mold 102 and the lower mold 104 are compressed

so as to deform the magnesium alloy billet 106 to a magnesium alloy product 110 having a shape corresponding to the mold 100. The upper mold 102 and the lower mold 104 are configured to have a space 108, and through which the excess magnesium alloy billet 106 can flow in the process of compression molding. After the compression molding, the magnesium alloy product 110 is processed by an edge deletion so as to have a more accurate shape. So, the conventional forging process is time-consuming and expensive.

SUMMARY OF EMBODIMENTS

[0007] Therefore, one object of the present invention is to provide a manufacture method for a magnesium alloy product capable of reducing cost and deforming a magnesium alloy product with an accurate size.

[0008] The present invention provides a manufacture method for a magnesium alloy product, which includes steps of: providing a mold, the mold comprising an upper mold and a lower mold, the upper mold having a punch, the lower mold having a cavity, the punch being adapted to be accommodated in the cavity; heating the mold so as to increase the temperature of the cavity to a determined degree; placing a magnesium alloy billet in the heated cavity; and compressing the upper and lower molds so as to drive the punch to deform the magnesium alloy billet to a magnesium alloy product having a shape corresponding to the cavity. The punch in the cavity and an inner wall of the cavity are configured to have a gap of 0.05mm~0.1mm.

[0009] In an embodiment of the present invention, the aforementioned manufacture method further, before the step of heating the mold, includes a step of: measuring the temperature of the cavity, and heating the mold according to the measured temperature.

[0010] In an embodiment of the present invention, the mold includes a heating pipe arranged an inside thereof, and the heating pipe is configured to heat the mold.

[0011] In an embodiment of the present invention, the magnesium alloy billet is an extrusion magnesium alloy.

[0012] In an embodiment of the present invention, the aforementioned manufacture method further, before the step of placing a magnesium alloy billet in the heated cavity, includes a step of: heating the magnesium alloy billet to 300°C~500°C. Preferably, the magnesium alloy billet is heated to 350°C~450°C.

[0013] In an embodiment of the present invention, the predetermined degree is configured in a range of 150°C~300°C. Preferably, the predetermined degree is 180°C~250°C.

[0014] In an embodiment of the present invention, the step of compressing the upper and lower molds is realized by a hydraulic press configured to supply press upon the upper mold.

[0015] In an embodiment of the present invention, the hydraulic press is configured to have a press speed of 10mm/sec~15mm/sec.

[0016] In summary, in the manufacture method of a magnesium alloy product according to the present invention, the compression molding is performed in an almost sealed cavity; thus, the magnesium alloy product can be deformed from the magnesium alloy billet without much flash. Moreover, because the magnesium alloy product can be manufactured without much flash fin, the flash deletion process is not needed any more and consequently the manufacture cost is reduced. In addition, the magnesium alloy product can have continuous streamlines and a better tensile strength.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The above embodiments will become more readily apparent to those ordinarily skilled in the art after reviewing the following detailed description and accompanying drawings, in which:

[0018] FIG. 1A is a schematic cross-sectional view of a conventional mold for a hot-forging process;

[0019] FIG. 1B is a schematic cross-sectional view of a magnesium alloy product manufactured by the mold shown in FIG. 1A;

[0020] FIG. 2 is a schematic flow chart illustrating a manufacture method of a magnesium alloy product in accordance with an embodiment of the present invention;

[0021] FIG. 3A is a schematic cross-sectional view of a mold adapted to use with the manufacture method illustrated in FIG. 2; and

[0022] FIG. 3B is a schematic cross-sectional view of a magnesium alloy product manufactured by the mold shown in FIG. 3A.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0023] The disclosure will now be described more specifically with reference to the following embodiments. It is to be noted that the following descriptions of preferred embodiments are presented herein for purpose of illustration and description only. It is not intended to be exhaustive or to be limited to the precise form disclosed.

[0024] FIG. 2 is a schematic flow chart illustrating a manufacture method of a magnesium alloy product in accordance with an embodiment of the present invention. FIG. 3A is a schematic cross-sectional view of a mold adapted to use with the manufacture method illustrated in FIG. 2. Referring to FIGS. 2, 3A both, firstly, a mold 310 is provided (step S210). In particular, the mold 310 is, for example, constituted by an upper mold 312 and a lower mold 314. The upper mold 312 has a punch 311. The lower mold 314 has a cavity 313. The punch 311 is adapted to be accommodated in the cavity 313.

[0025] Next, the mold 310 is heated so as to increase the temperature in the cavity 313 to a determined degree (step S220). In particular, the predetermined degree is configured in a range of 150°C~300°C. In the present embodiment, the predetermined degree is configured in

a range of 180°C~250°C.

[0026] Afterwards, a magnesium alloy billet 302 is placed in the heated cavity 313 (step S230). In the present embodiment, the magnesium alloy billet 302 is, for example, an extrusion magnesium alloy billet. In addition, the magnesium alloy billet 302 can, before being placed in the cavity 313, be heated so as to enlarge the molecular structure thereof and consequently have a semi-solid structure. For example, the magnesium alloy billet 302 can be heated to 400°C~500°C first and then placed in the cavity 313; preferably, the magnesium alloy billet 302 is heated to 350°C~450°C.

[0027] Afterwards, the upper mold 312 and the lower mold 314 are compressed to each other through a press upon the upper mold 312, and accordingly the punch 311 is driven to compress the magnesium alloy billet 302 in the cavity 313 so as to deform the magnesium alloy billet 302 to a magnesium product 304, as illustrated in FIG. 3B, having a shape corresponding to the cavity 313 (step S240). In particular, the punch 311 in the cavity 313 and an inner wall of the cavity 311 are configured to have a gap D in a range of 0.05mm to 0.1mm for the removal of air from the cavity 313.

[0028] Specifically, in the present embodiment, the press for the compression of the upper mold 312 and lower mold 314 is, for example, supplied by a hydraulic press (not shown). Through the press, the magnesium alloy billet 302 in the cavity 313 can be deformed to the magnesium alloy product 304 having a shape corresponding to the cavity 313.

[0029] Then, the upper mold 312 and lower mold 314 are separated from each other and the magnesium alloy product 304 with a one-piece structure accordingly is removed from the mold 310. In the present embodiment, the hydraulic press is configured to have a press speed in a range of 10mm/sec to 15mm/sec to perform the compression molding on the magnesium alloy billet 302.

[0030] It is to be noted that, the cavity 313 is an almost sealed space while the magnesium alloy billet 302 is being performed by the compression molding; in other words, the gap D between the upper mold 312 and the lower mold 314 is only configured for the removal of air and there is no space for the overflow of the excess magnesium alloy billet 302. In addition, to avoid a relatively large volume difference between the magnesium alloy billet 302 and the cavity 313 and thereby affecting the thickness tolerance of the magnesium alloy product 304, in the present embodiment the volume of the cavity 313, for the accommodation of the magnesium alloy billet 302, is previously calculated, for example, in a computer simulation manner, so the magnesium alloy product 304 can have a more accurate size and a better mechanical strength. Accordingly, after being removed from the cavity 313, the magnesium alloy product 304 can have a more refined appearance once the tiny flash fin 304a thereof is removed by the flash removal process.

[0031] In summary, in the manufacture method of a magnesium alloy product according to the present inven-

tion, the compression molding is performed in an almost sealed cavity; thus, the magnesium alloy product can be deformed from the magnesium alloy billet without much flash. Moreover, because the magnesium alloy product can be manufactured without much flash fin, the flash deletion process is not needed any more and consequently the manufacture cost is reduced. In addition, the magnesium alloy product can have continuous streamlines and a better tensile strength.

[0032] In addition, in one embodiment of the present invention, a magnesium alloy billet is heated to 400°C~500°C first, and then placed in a cavity for the compression molding. Thus, the manufactured magnesium alloy product can have some beneficial features, such as having a more uniform and compact mechanical strength.

[0033] While the disclosure has been described in terms of what is presently considered to be the most practical and preferred embodiments, it is to be understood that the disclosure needs not be limited to the disclosed embodiment. On the contrary, it is intended to cover various modifications and similar arrangements included within the scope of the appended claims which are to be accorded with the broadest interpretation so as to encompass all such modifications and similar structures.

Claims

1. A manufacture method for a magnesium alloy product, comprising steps of:

providing a mold, the mold comprising an upper mold and a lower mold, the upper mold having a punch, the lower mold having a cavity, the punch being adapted to be accommodated in the cavity;
 heating the mold so as to increase the temperature of the cavity to a determined degree;
 placing a magnesium alloy billet in the heated cavity; and
 compressing the upper and lower molds so as to drive the punch to deform the magnesium alloy billet to a magnesium alloy product having a shape corresponding to the cavity;
 wherein the punch in the cavity and an inner wall of the cavity are configured to have a gap of 0.05mm~0.1mm.

2. The manufacture method according to claim 1, further, before the step of heating the mold, comprising a step of:

measuring the temperature of the cavity, and heating the mold according to the measured temperature.

3. The manufacture method according to claim 1,

wherein the mold comprises a heating pipe arranged inside thereof, and the heating pipe is configured to heat the mold.

4. The manufacture method according to claim 1, wherein the magnesium alloy billet is an extrusion magnesium alloy.

5. The manufacture method according to claim 1, further, before the step of placing a magnesium alloy billet in the heated cavity, comprising a step of:

heating the magnesium alloy billet to 300°C~500°C.

6. The manufacture method according to claim 5, further, before the step of placing a magnesium alloy billet in the heated cavity, comprising a step of:

heating the magnesium alloy billet to 350°C~450°C.

7. The manufacture method according to claim 1, wherein the predetermined degree is configured in a range of 150°C~300°C.

8. The manufacture method according to claim 7, wherein the predetermined degree is configured in a range of 180°C~250°C.

9. The manufacture method according to claim 1, wherein the step of compressing the upper and lower molds is realized by a hydraulic press configured to supply press upon the upper mold.

10. The manufacture method according to claim 9, wherein the hydraulic press is configured to have a press speed of 10mm/sec~15mm/sec.

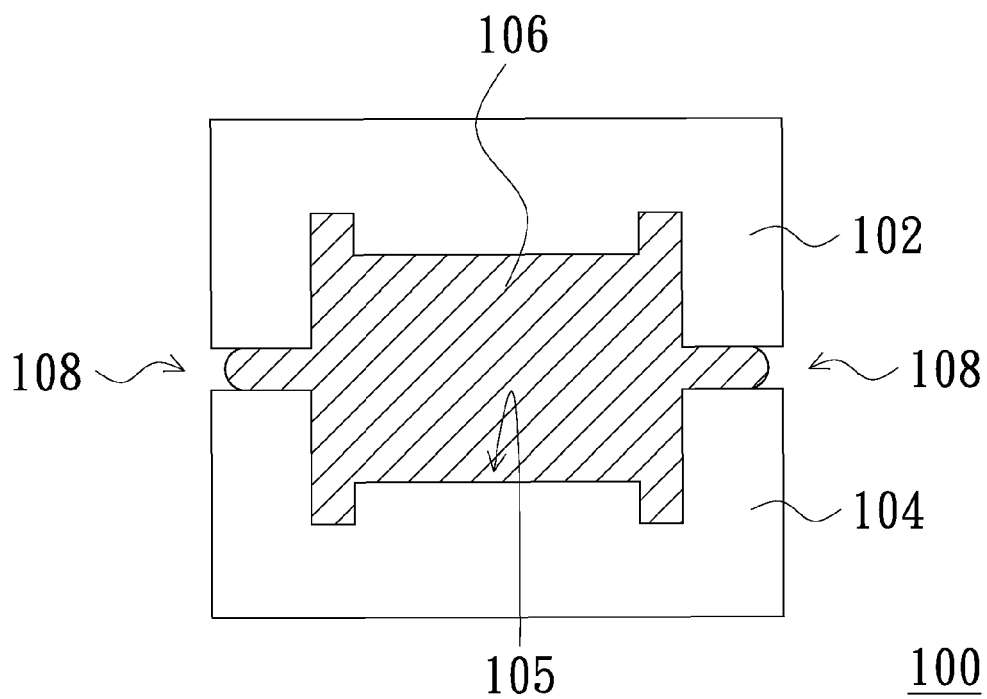


FIG. 1A (Prior Art)

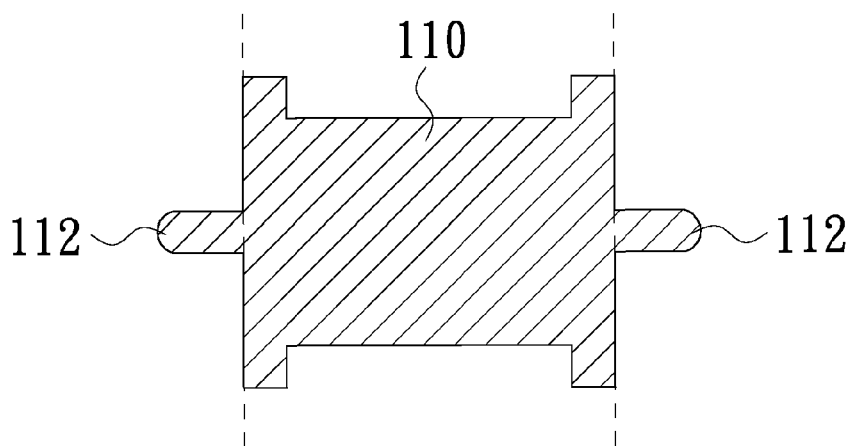


FIG. 1B (Prior Art)

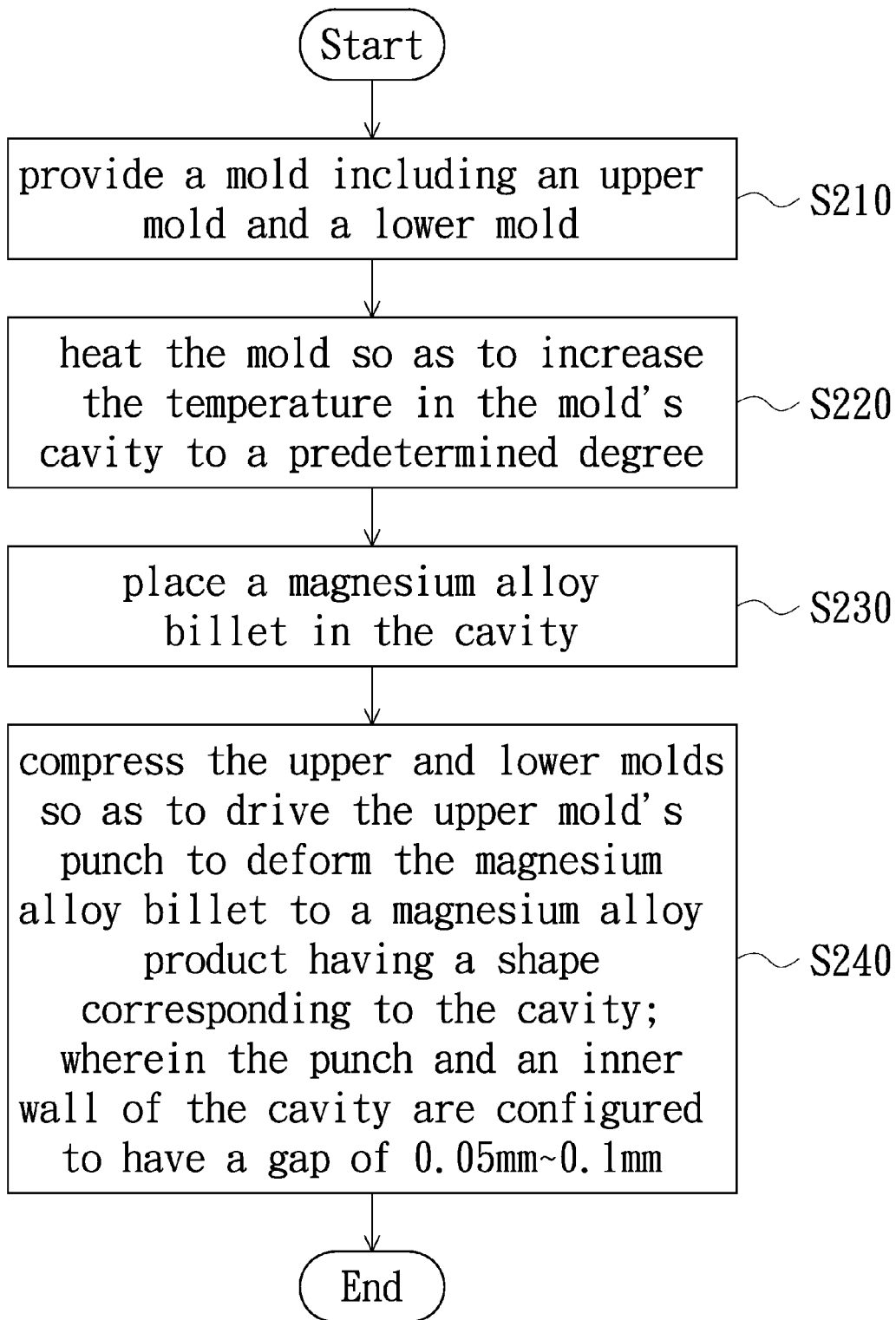


FIG. 2

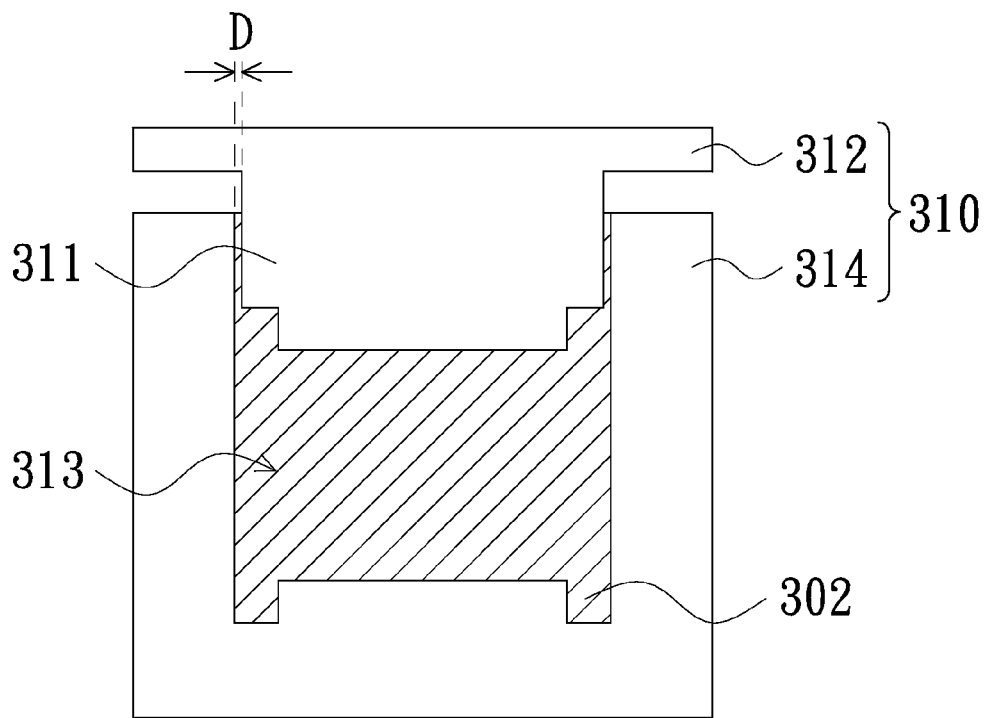


FIG. 3A

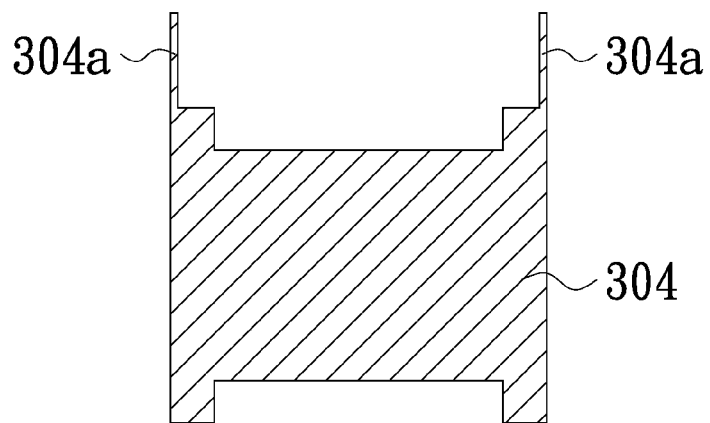


FIG. 3B



EUROPEAN SEARCH REPORT

Application Number
EP 12 18 9944

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search Munich		Date of completion of the search 19 March 2013	Examiner Radeck, Stephanie
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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