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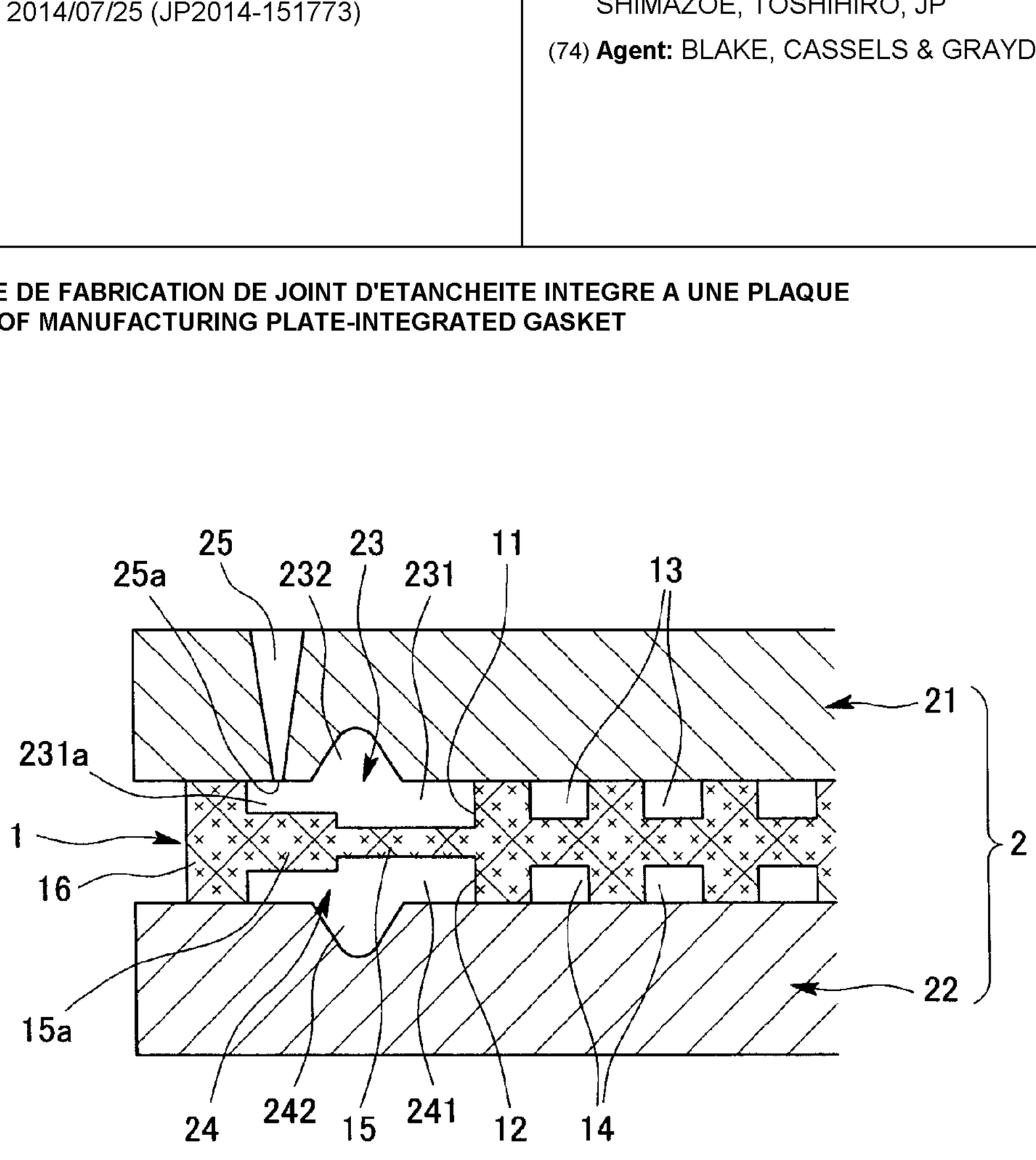
(54) **Titre : PROCEDE DE FABRICATION DE JOINT D'ETANCHEITE INTEGRE A UNE PLAQUE**
(54) **Title: METHOD OF MANUFACTURING PLATE-INTEGRATED GASKET**



(57) **Abrégé/Abstract:**
The purpose of the present invention is to effectively prevent a plate (1) formed of a fragile material, such as carbon, from being broken when a gasket main body formed of a rubber-like elastic material is integrally molded on both surfaces of the plate (1). In order to achieve this purpose, a plate-integrated gasket in which a gasket main body formed of a rubber-like elastic material is integrally provided on the thickness direction both sides of a portion along the peripheral edge of the plate (1) is manufactured such that a region (15) of the plate (1) is formed so as to have a thickness (15a) relatively thick at an opposing position to an opening portion (25a) of a gate (25) and also in the vicinity of the opposing position, said region (15) being positioned between gasket molding cavities (23, 24) demarcated by sandwiching and mold-clamping the plate (1) between the divided dies (21, 22) of a molding die (2), said gate (25) being used for injecting a molding material into the cavities (23, 24).

Abstract of Disclosure

To effectively prevent a breakage of a plate (1) when a gasket body formed of a rubber-like elastic material is integrally molded at both faces of the plate formed of a brittle material such as carbon. In order to attain this object, there is provided a method of manufacturing a plate-integrated gasket in which a gasket body formed of a rubber-like elastic material is integrally formed at both sides of a portion along a peripheral edge of a plate (1) in the thickness direction, where an area (15) located between gasket molding cavities (23, 24) defined by clamping the plate (1) between split dies (21, 22) of a metal mold (2) in the plate (1) is formed to be a relatively thick portion (15a) at a position, facing an opening (25a) of a gate (25) through which a molding material is injected into the cavities (23, 24), and in the vicinity thereof.

CA Application
Agent Ref: 60233/00017

SPECIFICATION

Title of the Invention

METHOD OF MANUFACTURING PLATE-INTEGRATED GASKET

BACKGROUND OF THE INVENTION

Field of the Invention

[0001]

The present invention relates to a method of manufacturing a plate-integrated gasket in which a gasket body formed of a rubber-like elastic material is integrally formed at both faces of a peripheral edge portion of a plate such as a separator constituting, for example, a fuel battery cell.

Description of the Conventional Art

[0002]

A fuel battery has a stack structure in which a plurality of fuel battery cells are stacked. Here, the fuel battery cell is formed in such a manner that a gas diffusion layer is disposed in the thickness direction at both sides of a membrane electrode assembly (MEA) having a pair of electrode layers at both faces of an electrolyte membrane and a separator is laminated thereon. A gasket for sealing a fuel gas or an oxidant gas is used in each fuel battery cell. As such a gasket, a plate-integrated gasket 100 shown in Fig. 7 is known in recent years.

[0003]

The plate-integrated gasket 100 shown in Fig. 7 has a configuration in which gasket bodies 102 and 103 formed of a rubber-like elastic material (a rubber material or

a synthetic resin material having rubber-like elasticity) are integrally formed at both sides in the thickness direction of a portion along a peripheral edge of a carbon plate 101 serving as a separator of a fuel battery cell. Here, the gasket bodies 102 and 103 respectively include base portions 102a and 103a which are charged into belt-shaped grooves 101a and 101b formed at both faces of the carbon plate 101 and seal lips 102b and 103b which are projected from intermediate portions thereof in the width direction. The base portions 102a and 103a formed at both sides in the thickness direction communicate with each other through a through-hole 101d opened in a thin portion 101c between the belt-shaped grooves 101a and 101b of the carbon plate 101.

[0004]

When such a plate-integrated gasket 100 is manufactured, a metal mold 200 shown in Figs. 8 and 9 is used to integrally mold the carbon plate 101 and the gasket bodies 102 and 103. That is, the carbon plate 101 is disposed to be positioned between split dies 201 and 202 of the metal mold 200 and a molding liquid rubber material is charged into cavities 203 and 204 defined between the split dies 201 and 202 and the belt-shaped grooves 101a and 101b at both faces of the carbon plate 101 by a clamping operation. A gate 205 which is a liquid rubber material supply port is opened only to the cavity 203. However, since the cavities 203 and 204 communicate with each other through the through-hole 101d opened in the carbon plate 101 as shown in Fig. 9, the liquid rubber material injected from the gate 205 to the cavity 203 flows from the cavity 203 into the cavity 204 through the through-hole 101d to be molded (see Citation List below).

PRIOR ART DOCUMENT

Patent Document

[0005]

Patent Document 1: JP 2004-245341 A

Patent Document 2: JP 2001-121584 A

SUMMARY OF THE INVENTION

Problem to be Solved by the Invention

[0006]

However, since the carbon plate 101 is brittle, there is concern that a breakage C caused by the liquid rubber material injection pressure applied from the gate 205 may occur in the thin portion 101c between the belt-shaped grooves 101a and 101b. Particularly, since the liquid rubber material injection pressure is directly applied from the gate 205 to the vicinity of the position facing the opening of the gate 205 in the thin portion 101c, the breakage C easily occurs. Further, as shown in Fig. 9, there is concern that the breakage C is caused from the through-hole 101d in a portion provided with the through-hole 101d.

[0007]

The invention is made in view of the above-described circumstances and a technical object of the invention is to provide a method of manufacturing a plate-integrated gasket capable of effectively preventing a breakage of a plate when a gasket body formed of a rubber-like elastic material is integrally formed at both faces of the plate formed of a brittle material such as carbon.

Means for Solving the Problem

[0008]

In order to effectively solve the above-described technical object, according to a first aspect of the invention, there is provided a method of manufacturing a plate-integrated gasket in which a gasket body formed of a rubber-like elastic material is integrally formed at both sides of a peripheral edge portion of a plate in the thickness direction, in which an area located between gasket molding cavities defined by clamping the plate between split dies of a metal mold in the plate is formed to be relatively thick at a position, facing an opening of a gate through which a molding material is injected into the cavities, and in the vicinity of the position.

[0009]

According to the above-described method, when a molding material is injected from the gate into the gasket molding cavities defined at both sides in the thickness direction of the portion along the peripheral edge of the plate by clamping the plate between the split dies of the metal mold, the gasket body formed of the rubber-like elastic material is integrally formed at both sides of the portion along the peripheral edge of the plate in the thickness direction. In the clamping operation, the plate receives a molding material injection pressure applied from the gate by the relatively thick portion in an area between the cavities since an area located between the cavities in the plate is formed at a position facing the opening of the gate and in the vicinity of the position to be relatively thick. Then, since the portion is relatively thick, the mechanical strength is improved. For this reason, even when the plate is formed of a brittle material, a breakage caused by the molding material injection pressure hardly occurs.

[0010]

According to a second aspect of the invention, there is provided the method of manufacturing the plate-integrated gasket according to the first aspect, in which a through-hole communicating the cavities at both side of the plate in the thickness direction is opened while being located at a relatively thick portion.

[0011]

According to the above-described method, since a portion provided with the through-hole is relatively thick, a breakage from the through-hole hardly occurs.

[0012]

According to a third aspect of the invention, there is provided the method of manufacturing the plate-integrated gasket according to the first or second aspect, in which the relatively thick portion extends from a sandwiched portion sandwiched by the metal mold.

[0013]

According to the above-described method, since the relatively thick portion is supported by the sandwiched portion sandwiched between the split dies of the metal mold, a breakage caused by the molding material injection pressure hardly occurs.

[0014]

According to a fourth aspect of the invention, there is provided the method of manufacturing the plate-integrated gasket according to any one of the first to third aspects, in which an extension portion is formed at a part of the cavity in the extension direction so that the cavity extends in the width direction, the gate is opened toward the extension portion, and the relatively thick portion in the area located between the cavities in the plate is formed to be located at the extension portion.

[0015]

According to the above-described method, the mechanical strength of the relatively thick portion in an area located between the cavities in the plate is further improved.

Effect of the Invention

[0016]

According to a method of manufacturing a plate-integrated gasket of the invention, it is possible to effectively prevent a breakage of a plate due to a molding material injection pressure applied from a gate when a gasket body formed of a rubber-like elastic material is integrally formed at both faces of the plate formed of a brittle material such as carbon.

BRIEF EXPLANATION OF THE DRAWINGS

[0017]

Fig. 1 is a partially cross-sectional view showing a method of manufacturing a plate-integrated gasket according to a first embodiment of the invention in a state where a metal mold is clamped;

Fig. 2 is a partially cross-sectional view showing a plate-integrated gasket manufactured by the first embodiment;

Fig. 3 is a partially cross-sectional view showing a method of manufacturing a plate-integrated gasket according to a second embodiment of the invention in a state where a metal mold is clamped;

Fig. 4 is an explanatory diagram showing a method of manufacturing a plate-integrated gasket according to a third embodiment of the invention;

Fig. 5 is a cross-sectional view taken along a line A-A' of Fig. 4;

Fig. 6 is an explanatory diagram showing a partially modified example of the third embodiment shown in Fig. 4;

Fig. 7 is a partially cross-sectional view showing a plate-integrated gasket manufactured by the related art;

Fig. 8 is a partially cross-sectional view showing an example of a method of manufacturing a plate-integrated gasket according to the related art in a state where a metal mold is clamped; and

Fig. 9 is a partially cross-sectional view taken along a cutting position different from Fig. 8 in a state where a metal mold is clamped.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0018]

Hereinafter, a method of manufacturing a plate-integrated gasket according to a preferred embodiment of the invention will be described with reference to the drawings.

[0019]

Fig. 1 shows a first embodiment and Fig. 2 shows a plate-integrated gasket manufactured by a method of the first embodiment. First, in Fig. 1, Reference Numeral 1 indicates a plate assembled as a separator into a fuel battery cell and Reference Numeral 2 indicates a metal mold used to integrally injection-mold gasket bodies 3 and 4 formed at both sides of the peripheral edge portion of the plate 1 in the thickness direction and formed of a rubber-like elastic material (a rubber material or a synthetic resin material having rubber-like elasticity) as shown in Fig. 2.

[0020]

The plate 1 is molded by carbon. Here, both faces of the plate in the thickness direction are provided with belt-shaped grooves 11 and 12 extending along peripheral

edges (outer peripheral edges and opening edges) to have a symmetrical cross-sectional shape in the thickness direction and both faces at the inner areas of the belt-shaped grooves 11 and 12 in the thickness direction are provided with a plurality of flow grooves 13 and 14 used to circulate a reaction gas (a fuel gas and an oxidant gas) to the fuel battery cell.

[0021]

The metal mold 2 includes split dies 21 and 22 capable of sandwiching the plate 1. That is, when the plate 1 is disposed to be positioned between the split dies 21 and 22 and is clamped, gasket molding cavities 23 and 24 are respectively defined among the split dies 21 and 22 and the belt-shaped grooves 11 and 12 at both sides of the peripheral edge portion of the plate 1 in the thickness direction. The cavities 23 and 24 have cross-sectional shapes corresponding to the negative-positive positions of the gasket bodies 3 and 4 shown in Fig. 2,

That is, the cavities respectively include base portion molding portions 231 and 241 which correspond to base portions 31 and 41 charged into the belt-shaped grooves 11 and 12 of the plate 1 and seal lip molding portions 232 and 242 which correspond to seal lips 32 and 42 protruding in a mountain shape from the intermediate portions of the base portions 31 and 41 in the width direction. Both cavities 23 and 24 communicate with each other through a through-hole (not shown) opened between both cavities 23 and 24.

[0022]

Further, a gate 25 which is a molding liquid rubber material supply port is opened in one split die 21 and an opening 25a at the downstream end of the gate 25 is located at a position near an outer peripheral portion 231a of the base portion molding portion

231 of one cavity 23 defined between the belt-shaped groove 11 of the plate 1 and the split die 21 when the metal mold 2 is clamped.

[0023]

In the plate 1, a thick portion 15a, which is formed at a position facing the opening 25a of the gate 25 to be relatively thick in the vicinity thereof, is formed at an area between the cavities 23 and 24 defined while being sandwiched between the split dies 21 and 22 of the metal mold 2, in other words, a portion 15 between the belt-shaped grooves 11 and 12. The thick portion 15a may be formed to protrude from a sandwiched portion 16 sandwiched between the split dies 21 and 22 at the outer peripheries of the cavities 23 and 24 (the belt-shaped grooves 11 and 12) and to be continuous in the extension direction of the cavities 23 and 24 (the belt-shaped grooves 11 and 12), that is, a direction orthogonal to the cross-section of the drawing.

[0024]

Then, in a case where the gasket bodies 3 and 4 are molded to be integrated with the plate 1, a molding liquid rubber material is injected into the cavities 23 and 24 defined at both sides of the plate 1 in the thickness direction in the clamping state shown in Fig. 1. Specifically, the liquid rubber material is first charged into one cavity 23 from the gate 25 opened at one split die 21 and then is charged into the other cavity 23 through a through-hole (not shown) opened in the portion 15 between the belt-shaped grooves 11 and 12.

[0025]

At this time, the plate 1 receives a liquid rubber material injection pressure from the opening 25a of the gate 25 by the thick portion 15a at the portion 15 between the cavities 23 and 24 (the belt-shaped grooves 11 and 12). Then, the thick portion 15a is

a portion that has high mechanical strength in the portion 15 between the cavities 23 and 24 (the belt-shaped grooves 11 and 12) and is supported by the sandwiched portion 16 sandwiched between the split dies 21 and 22 at the outer peripheries of the cavities 23 and 24 (the belt-shaped grooves 11 and 12). For this reason, even when the plate 1 is molded by carbon, a breakage caused by the liquid rubber material injection pressure is effectively prevented.

[0026]

Then, when the liquid rubber material charged into the cavities 23 and 24 is cross-linked and cured, the gasket bodies 3 and 4 formed by the rubber-like elastic material and integrated with the plate 1 are molded as shown in Fig. 2.

[0027]

Fig. 3 shows a method of manufacturing a plate-integrated gasket according to a second embodiment of the invention. The second embodiment is different from the first embodiment in that a through-hole 17 communicating the cavities 23 and 24 at both sides of the plate 1 in the thickness direction is opened at the relative thick portion 15a. Further, the through-hole 17 exists at a position facing the opening 25a of the gate 25. In this way, it is possible to effectively prevent a breakage from the through-hole 17 caused by the liquid rubber material injection pressure applied from the gate 25.

[0028]

Figs. 4 and 5 show a method of manufacturing a plate-integrated gasket according to a third embodiment of the invention. The third embodiment is different from the first embodiment in that extension portions 233 and 243 are formed in a part of the cavities 23 and 24 in the extension direction so that the cavities 23 and 24 extend outward in the width direction, the opening 25a of the gate 25 is opened at one

extension portion 233, and the relative thick portion 15a in the portion 15 between the cavities 23 and 24 of the plate 1 is positioned between the extension portions 233 and 243. Then, as shown in Fig. 5, since notch portions 11a and 12a which are notched shallowly toward the peripheral edges of the plate 1 are formed at a predetermined interval in a part of the belt-shaped grooves 11 and 12 of the plate 1 in the extension direction, the extension portions 233 and 243 are formed between the notch portions 11a and 12a and the inner faces of the metal molds by the clamping operation and the thick portion 15a is formed as a portion between the notch portions 11a and 12a.

[0029]

Further, the through-hole 17 communicating the cavities 23 and 24 at both sides of the plate 1 in the thickness direction is opened at the thick portion 15a. In other words, the through-hole is opened while being positioned inside the extension portions 233 and 243. Further, the through-hole 17 exists at a position facing the opening 25a of the gate 25.

[0030]

According to this method, a portion which is formed by cross-linking and curing the liquid rubber material flowing into the extension portions 233 and 243 of the cavities 23 and 24 during the molding operation becomes projection portions 33 and 43 which are projected in the width direction from the base portions 31 and 41 charged into the belt-shaped grooves 11 and 12 of the plate 1 of the gasket bodies 3 and 4. Then, since the thick portion 15a facing the opening 25a of the gate 25 in the plate 1 is formed to be surrounded by the rising faces of the extension portions 233 and 243 (the notch portions 11a and 12a), that is, the sandwiched portion 16, the mechanical strength for the liquid rubber material injection pressure applied from the gate 25 is further improved.

Further, even when a "sink" or the like occurs in the vicinity of the through-hole 17 due to the contracted volume of the rubber material in the cross-linking and curing state, the "sink" occurs in the projection portions 33 and 43 projected from the base portions 31 and 41 of the gasket bodies 3 and 4 in the width direction. For this reason, it is possible to effectively prevent a bad influence on the base portions 31 and 41 or the seal lips 32 and 42 due to the "sink".

[0031]

Then, the molded plate-integrated gasket can have a uniform sealing property since a portion other than the projection portions 33 and 43 has a cross-sectional shape shown in Fig. 5.

[0032]

Fig. 6 shows a partially modified example of the third embodiment. That is, in the above-described example of Fig. 4, the through-hole 17 communicating the cavities 23 and 24 at both sides of the plate 1 in the thickness direction is opened at an intermediate portion of the thick portion 15a (the extension portions 233 and 243), but in the modified example, the through-hole is opened at the rising faces of the extension portions 233 and 243. With such a configuration, the mechanical strength of the thick portion 15a for the liquid rubber material injection pressure applied from the gate 25 is further improved. Accordingly, it is possible to effectively prevent a breakage from the through-hole 17 caused by the liquid rubber material injection pressure applied from the gate 25.

Description of Reference Numerals

[0033]

1 Plate

11, 12 Belt-shaped groove

15a Thick portion

16 Sandwiched portion

17 Through-hole

2 Metal mold

21, 22 Split die

23, 24 Cavity

233, 243 Extension portion

25 Gate

3, 4 Gasket body

33, 43 Projection portion

What is claimed is:

1. A method of manufacturing a plate-integrated gasket in which a gasket body formed of a rubber-like elastic material is integrally formed at both sides of a peripheral edge portion of a plate in the thickness direction,

wherein an area located between gasket molding cavities defined by clamping the plate between split dies of a metal mold in the plate is formed to be relatively thick at a position, facing an opening of a gate through which a molding material is injected into the cavities, and in the vicinity of the position.

2. The method of manufacturing the plate-integrated gasket according to claim 1,

wherein a through-hole communicating the cavities at both side of the plate in the thickness direction is opened while being located at a relatively thick portion.

3. The method of manufacturing the plate-integrated gasket according to claim 1 or 2,

wherein the relatively thick portion extends from a sandwiched portion sandwiched by the metal mold.

4. The method of manufacturing the plate-integrated gasket according to any one of claims 1 to 3,

wherein an extension portion is formed at a part of the cavity in the extension direction so that the cavity extends in the width direction, the gate is opened toward the extension portion, and the relatively thick portion in the area located between the cavities in the plate is formed to be located at the extension portion.

FIG. 1

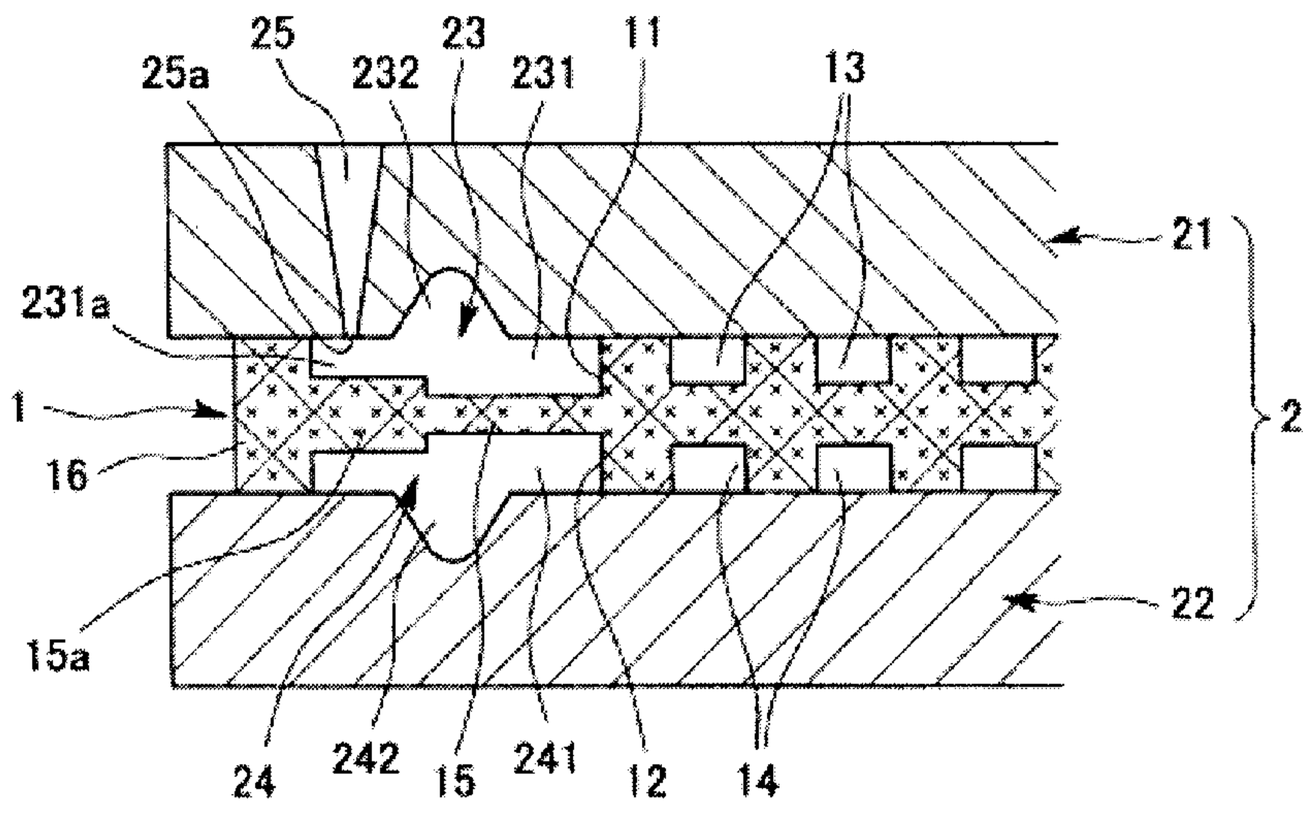
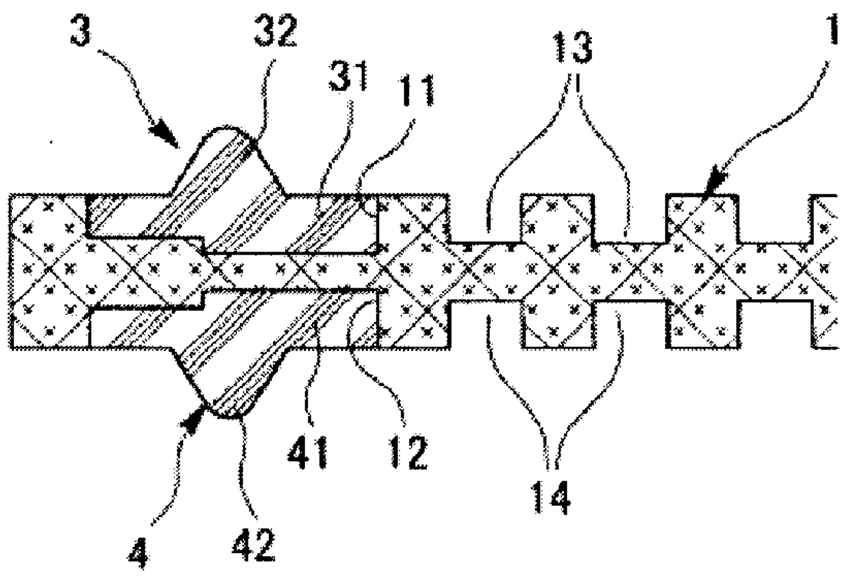

25
23
11
25a
232
231
13
21
231a
1
16
2
22
15a
24
242
15
241
12
14

FIG. 2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1
41
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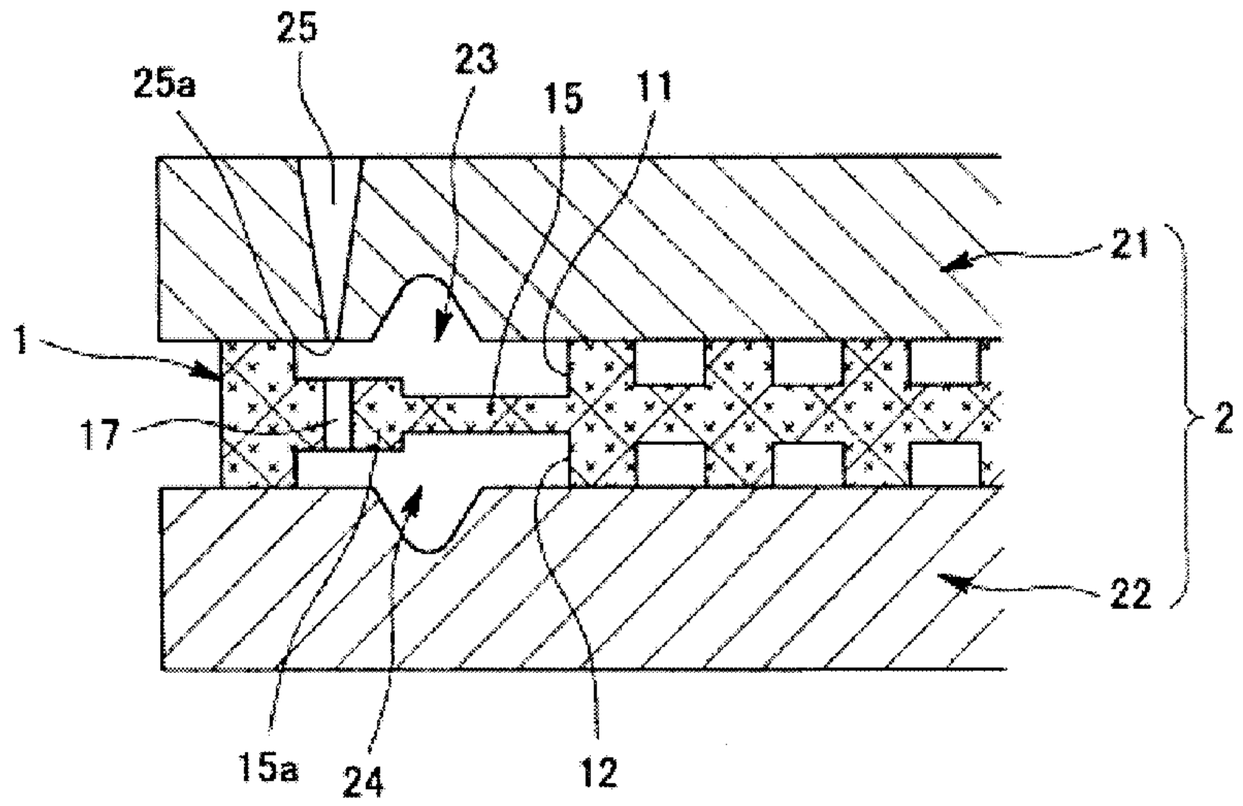
4
42

FIG. 3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23
25a
15
11
21
1
17
2
22
15a
24
12

FIG. 4

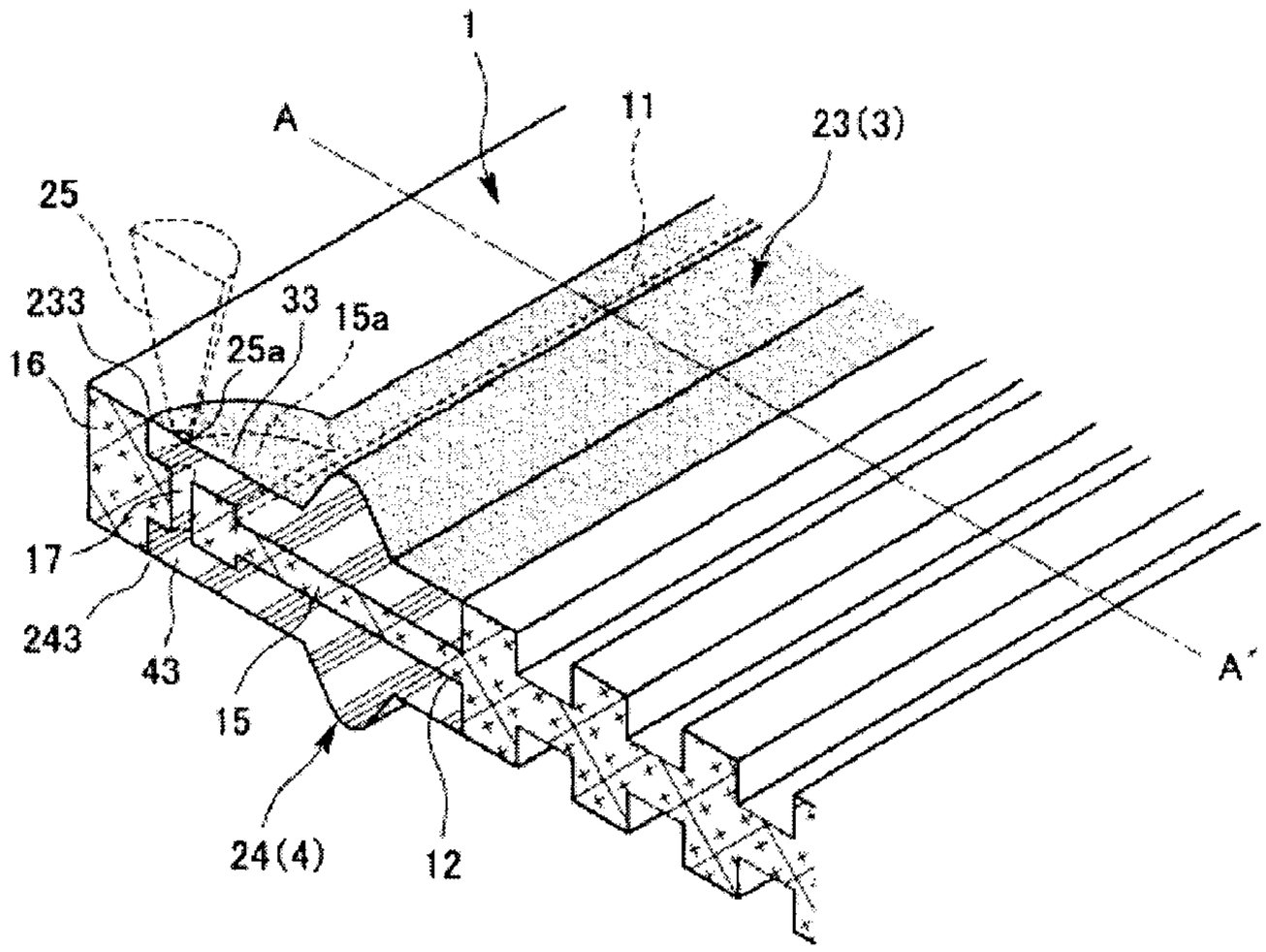

1
A
11
23(3)
25
233
33
15a
25a
16
17
243
43
15
24(4)
12
A'

FIG. 5

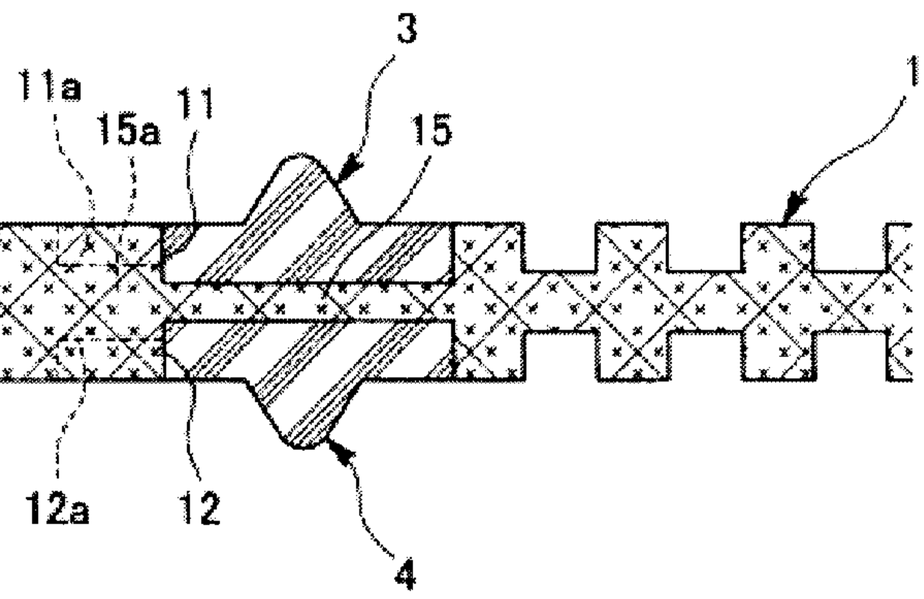
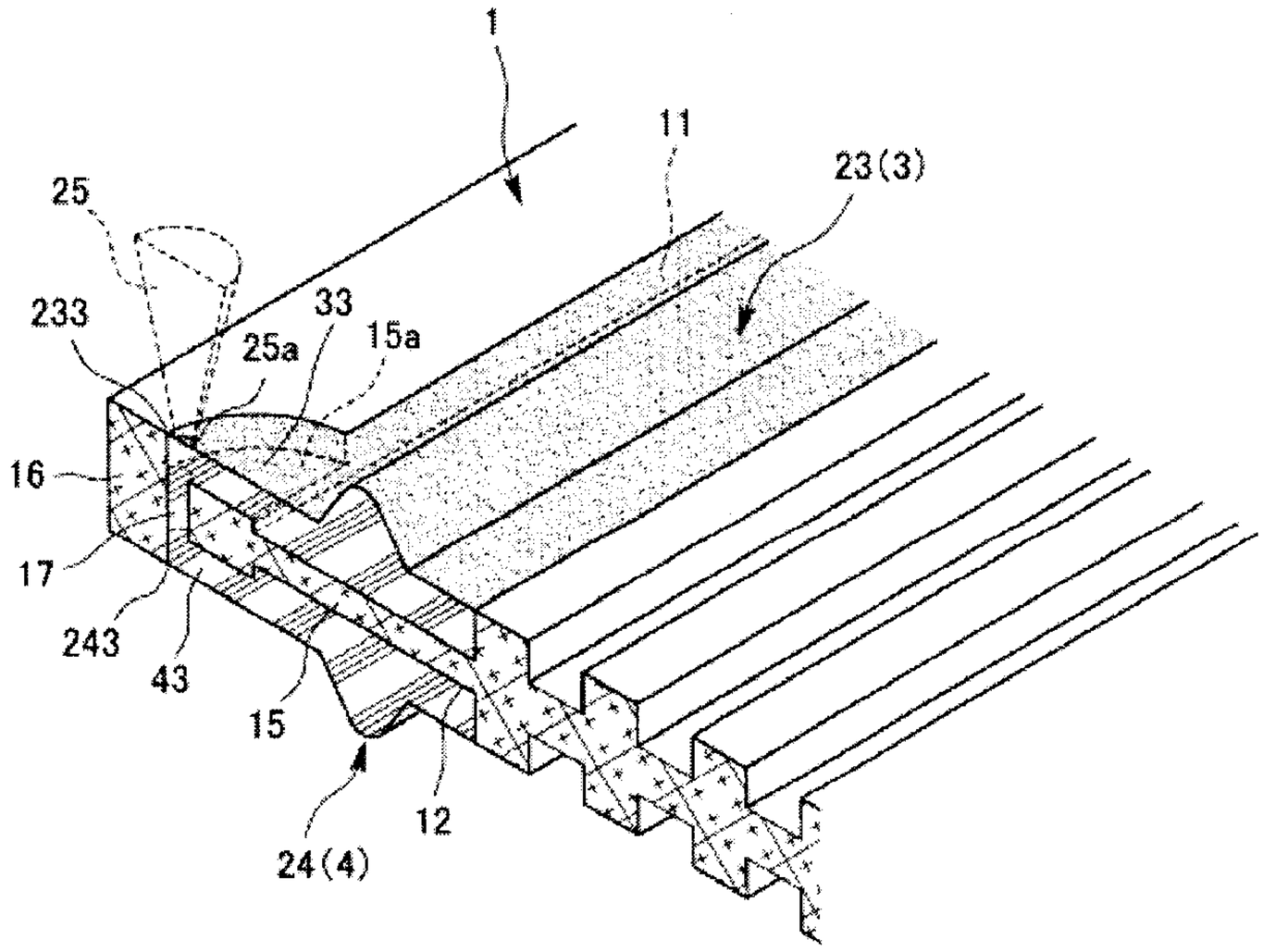

3
11a
15a
11
15
1
12a
12
4

FIG. 6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233
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15a
16
17
243
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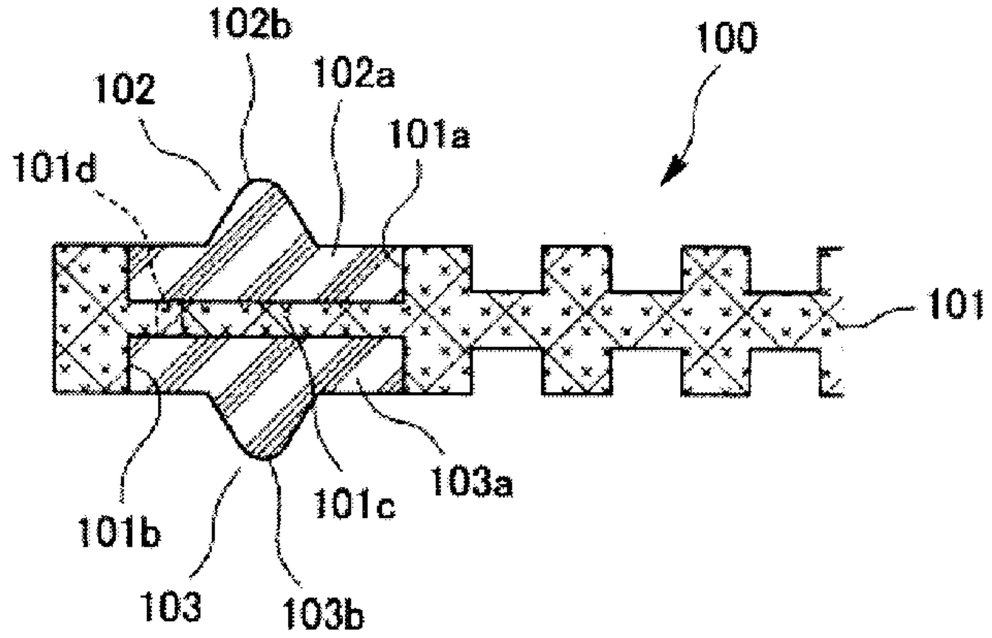
15
12
24(4)

FIG. 7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101d
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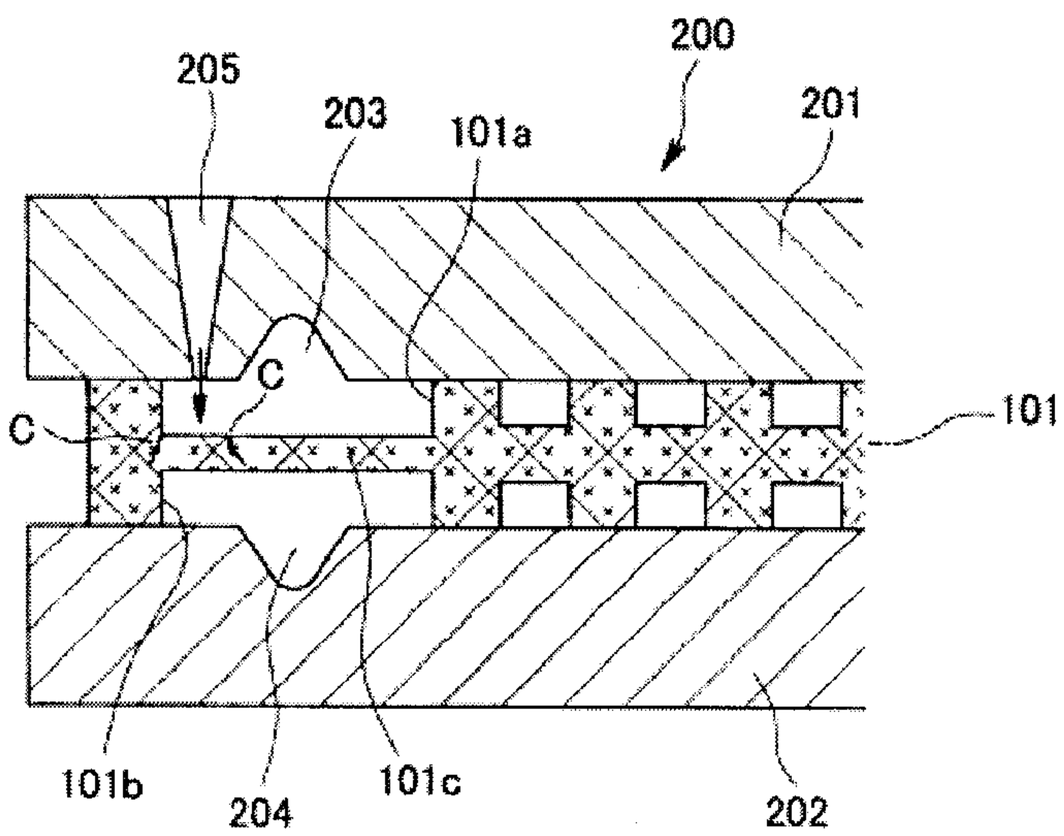
103
103b

FIG. 8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201
C
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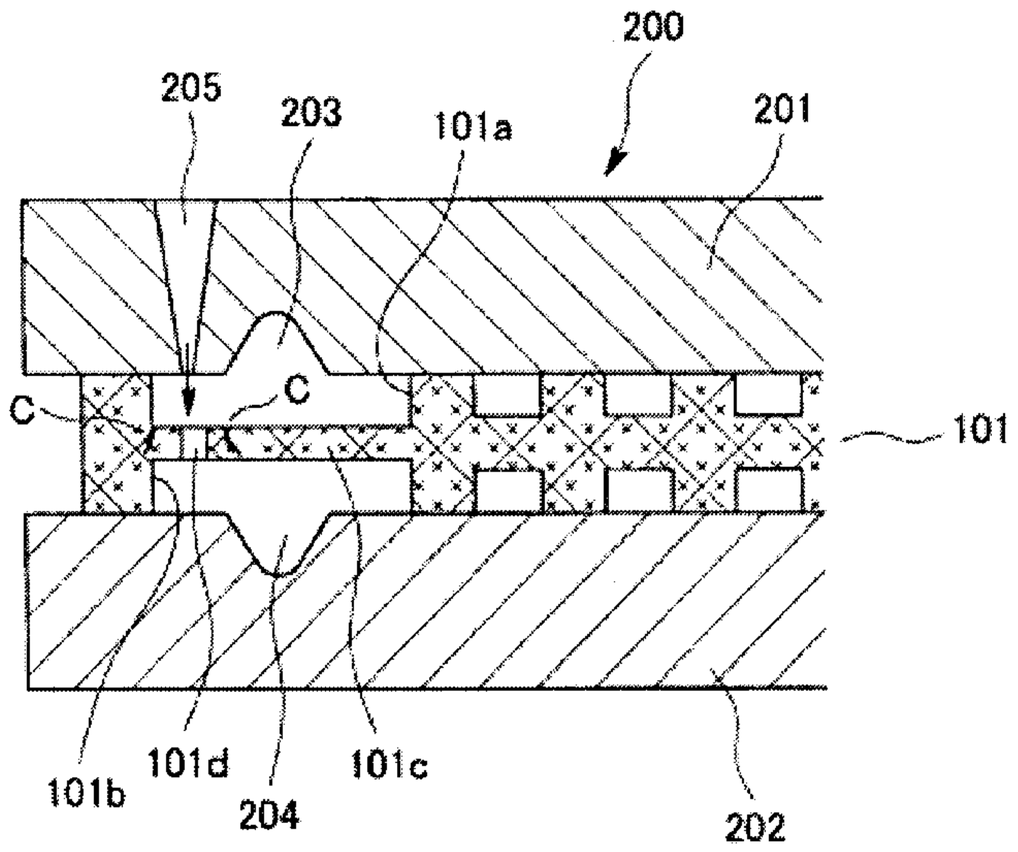
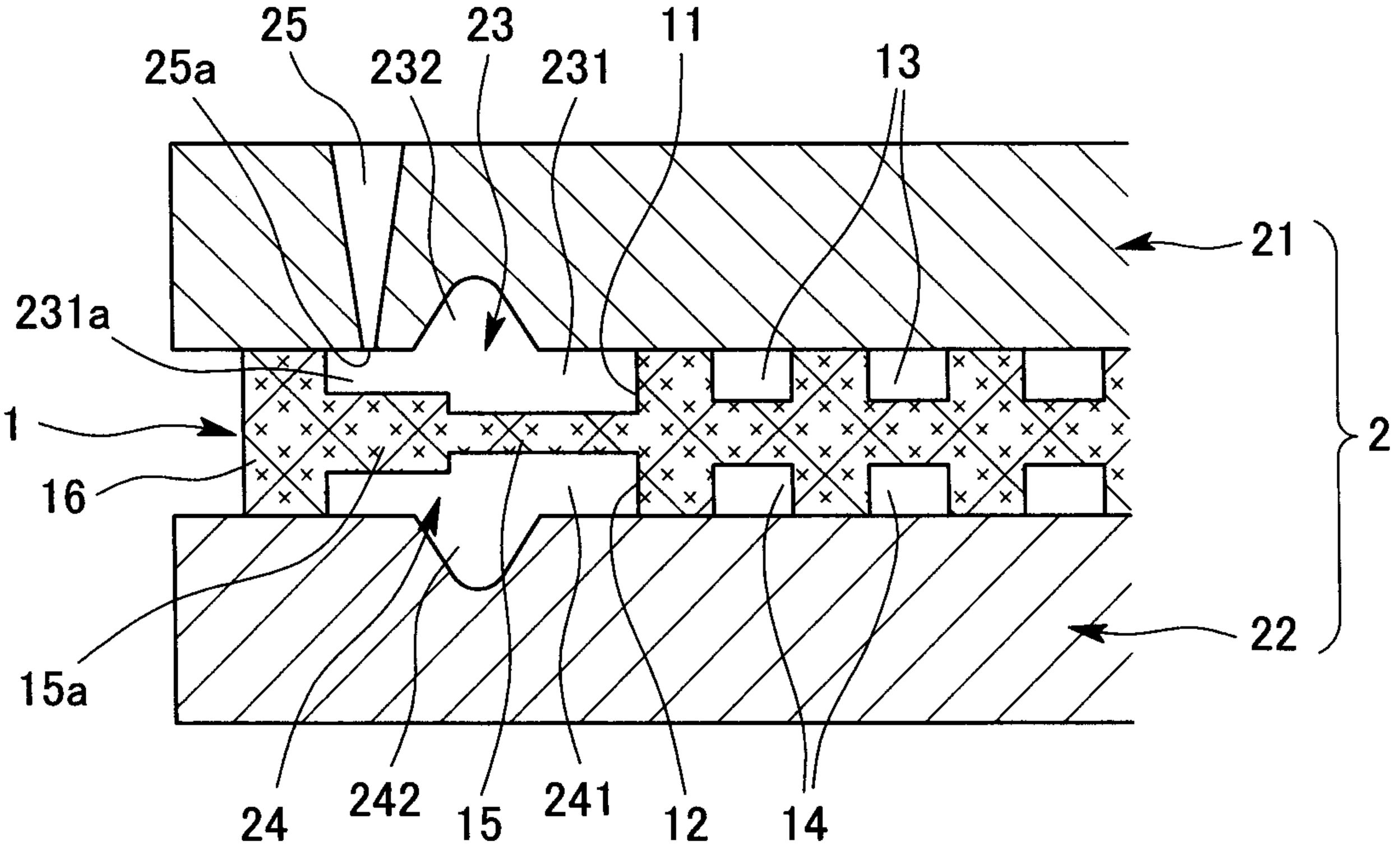
101
101b
204
101c
202

FIG. 9

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