US012390964B2

(12) **United States Patent**
Takahashi et al.

(10) **Patent No.: US 12,390,964 B2**
(45) **Date of Patent: Aug. 19, 2025**

(54) **MOLD, DEGASSING TOOL, AND METHOD FOR PRODUCING RESIN FOAM**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 41 days.

(21) Appl. No.: **18/254,663**

(22) PCT Filed: **May 12, 2021**

(86) PCT No.: **PCT/JP2021/018123**
§ 371 (c)(1),
(2) Date: **May 26, 2023**

(87) PCT Pub. No.: **WO2022/113399**
PCT Pub. Date: **Jun. 2, 2022**

(65) **Prior Publication Data**

US 2023/0415386 A1 Dec. 28, 2023

(30) **Foreign Application Priority Data**

Nov. 27, 2020 (JP) 2020-197384

(51) **Int. Cl.**
B29C 44/58 (2006.01)
B29K 105/04 (2006.01)

(52) **U.S. Cl.**
CPC ***B29C 44/588*** (2013.01); *B29K 2105/04* (2013.01)

(58) **Field of Classification Search**
CPC B29C 44/588; B29K 2105/04
USPC 264/51
See application file for complete search history.

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(74) *Attorney, Agent, or Firm* — KENJA IP LAW PC

(57) **ABSTRACT**

A mold **200** is a mold for molding a foam body, the mold including: a mold body portion **260**; and a degassing tool **270** attached to the mold body portion. The degassing tool is formed of porous metal, and a surface **270***a* of the degassing tool that is on a side of a cavity of the mold forms part of a molding surface S of the mold.

18 Claims, 13 Drawing Sheets

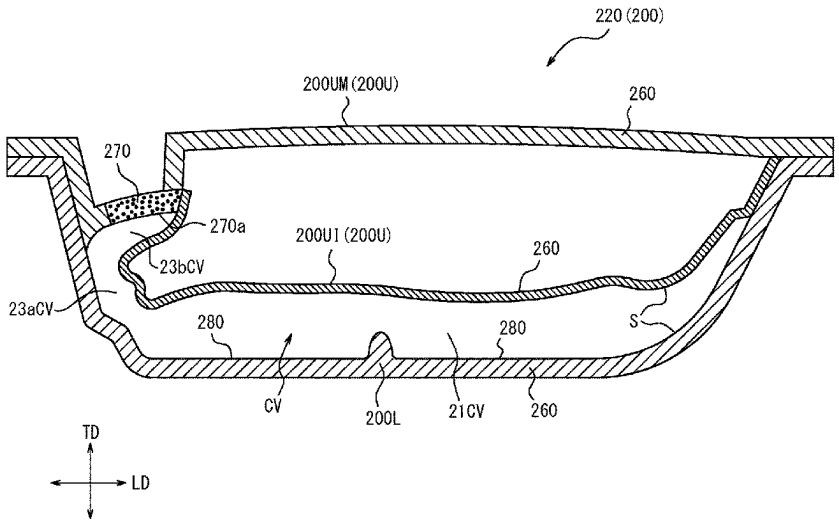

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FIG. 1

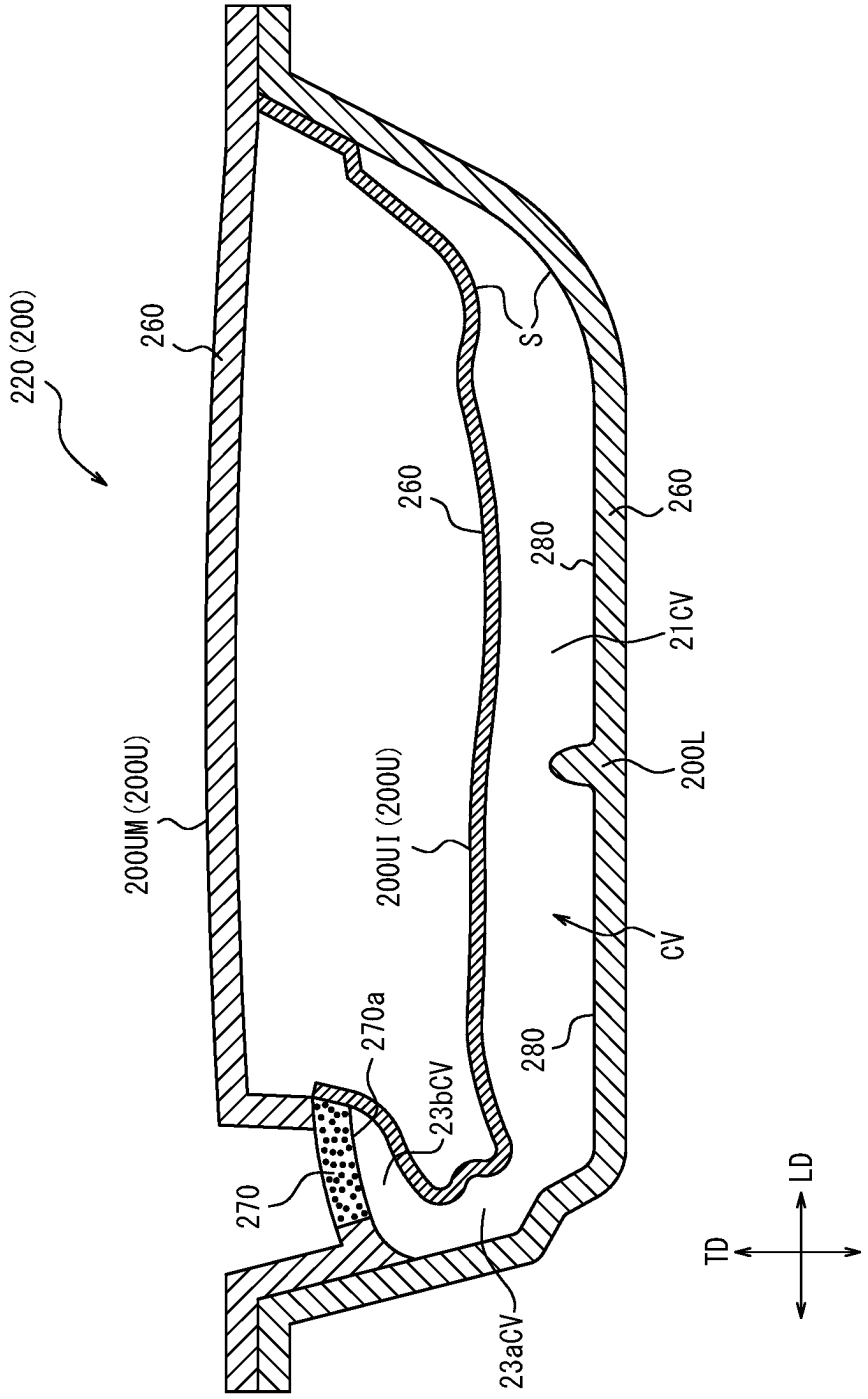

220 (200)
260
S
260
260
280
21CV
200L
200UM (200U)
200UI (200U)
CV
270a
280
23bCV
270
23aCV
TD
LD

FIG. 2

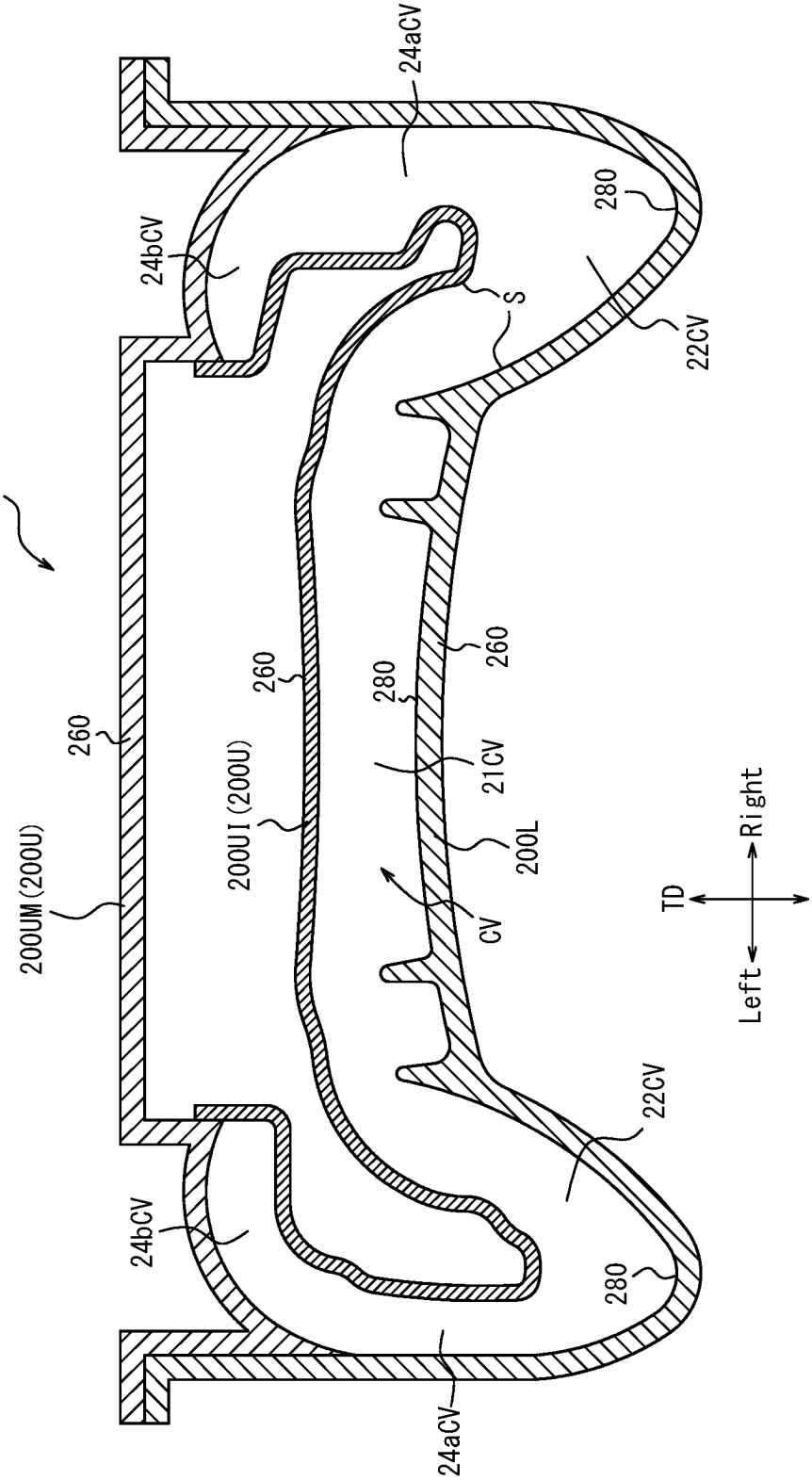

24aCV
280
24bCV
S
22CV
220 (200)
260
260
280
260
200UM (200U)
200UI (200U)
21CV
200L
CV
TD
Right
Left
22CV
24bCV
280
24aCV

FIG. 3

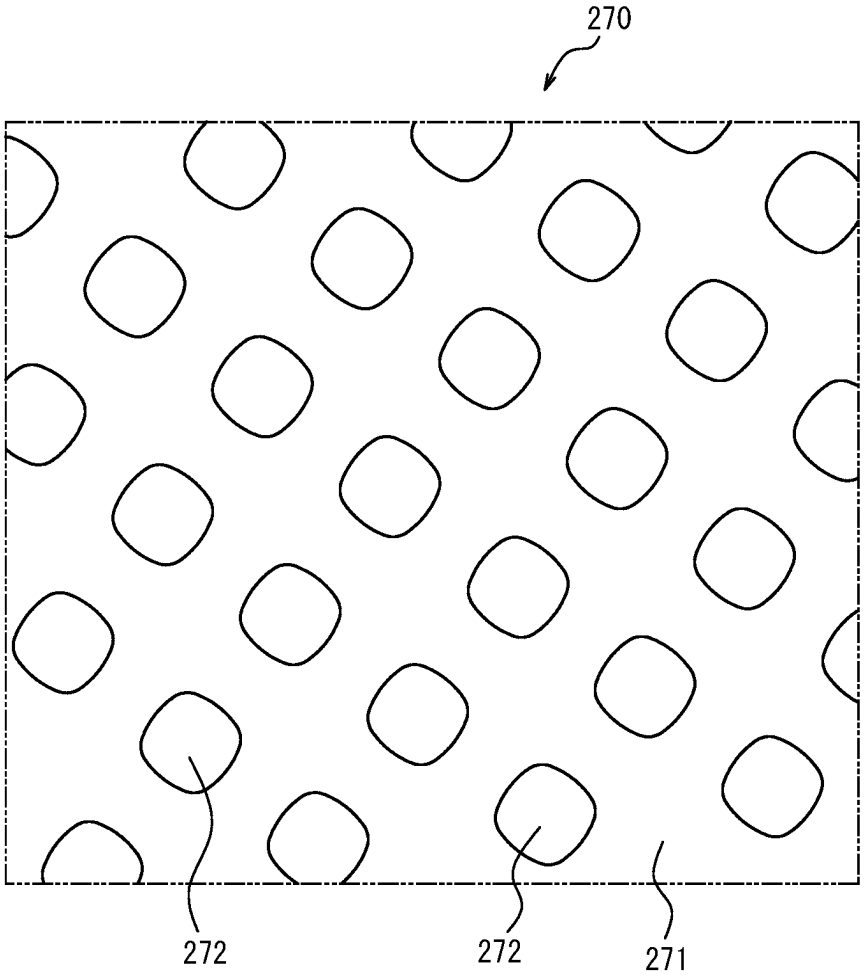


FIG. 4

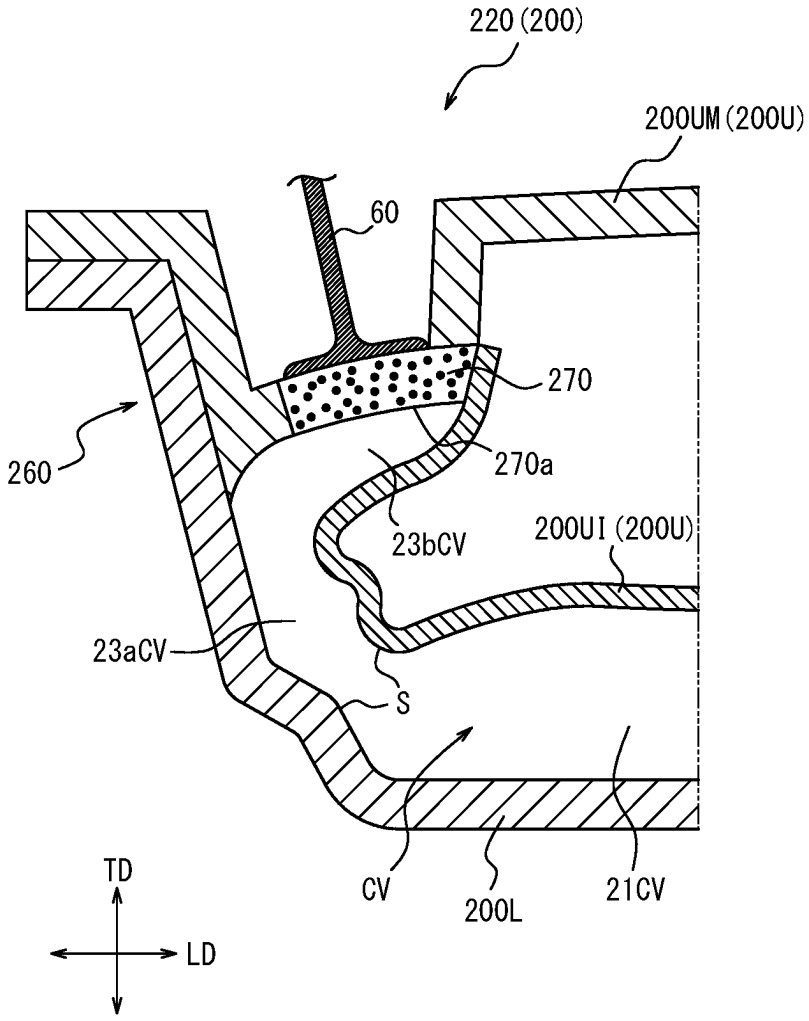

220 (200)
200UM (200U)
60
270
260
270a
23bCV
200UI (200U)
23aCV
S
CV
200L
21CV
TD
LD

FIG. 5

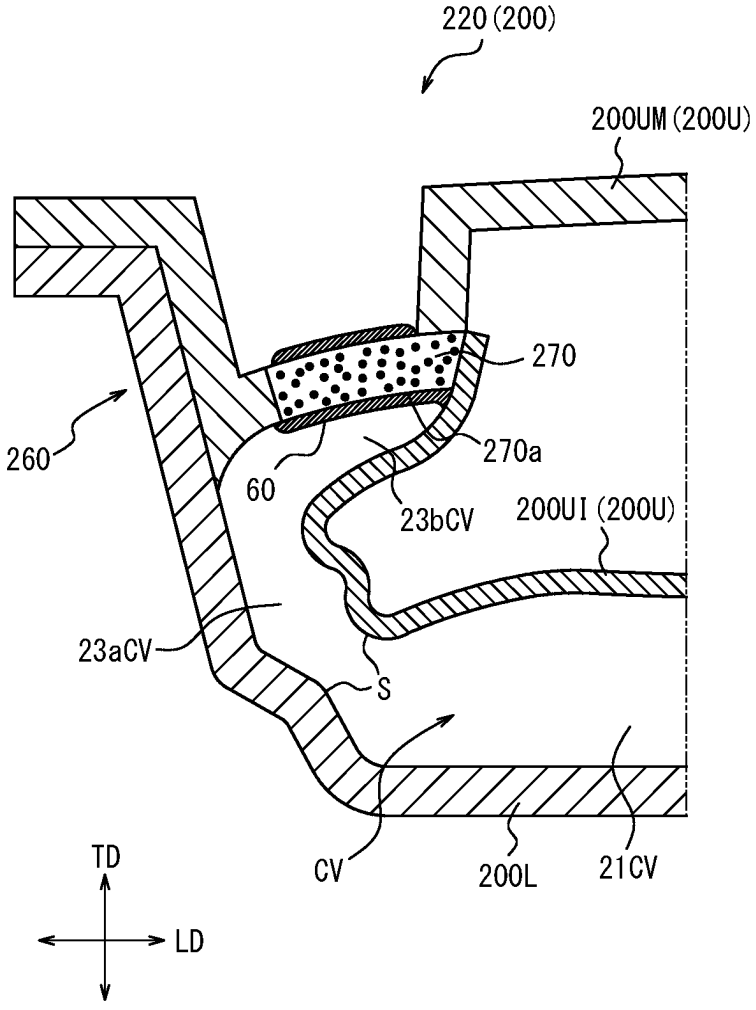

220 (200)
200UM (200U)
270
260
270a
60
23bCV
200UI (200U)
23aCV
S
TD
LD
CV
200L
21CV

FIG. 6

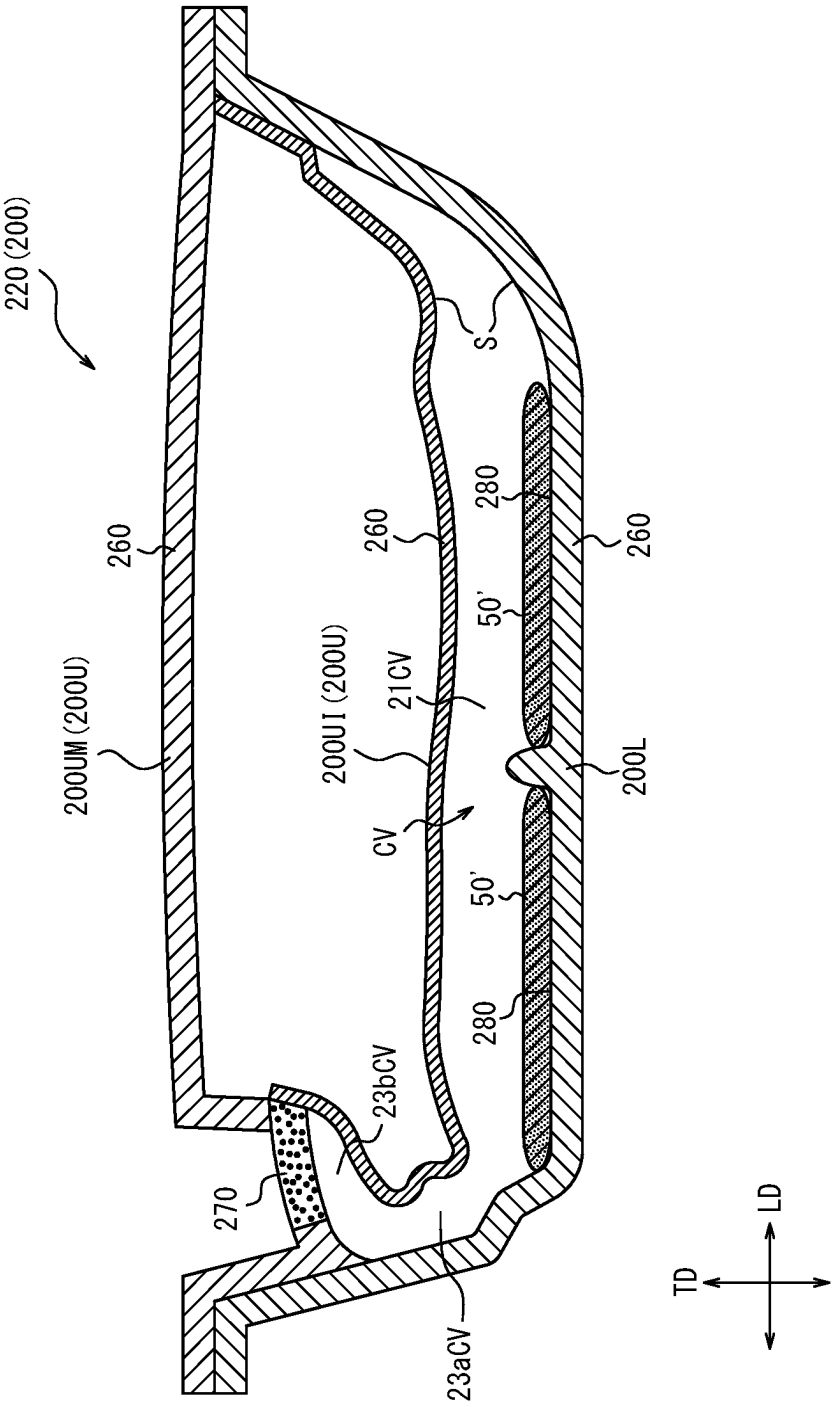

220 (200)
S
260
260
280
260
50'
200UM (200U)
200UI (200U)
21CV
200L
CV
50'
280
23bCV
270
23aCV
TD
LD

FIG. 7

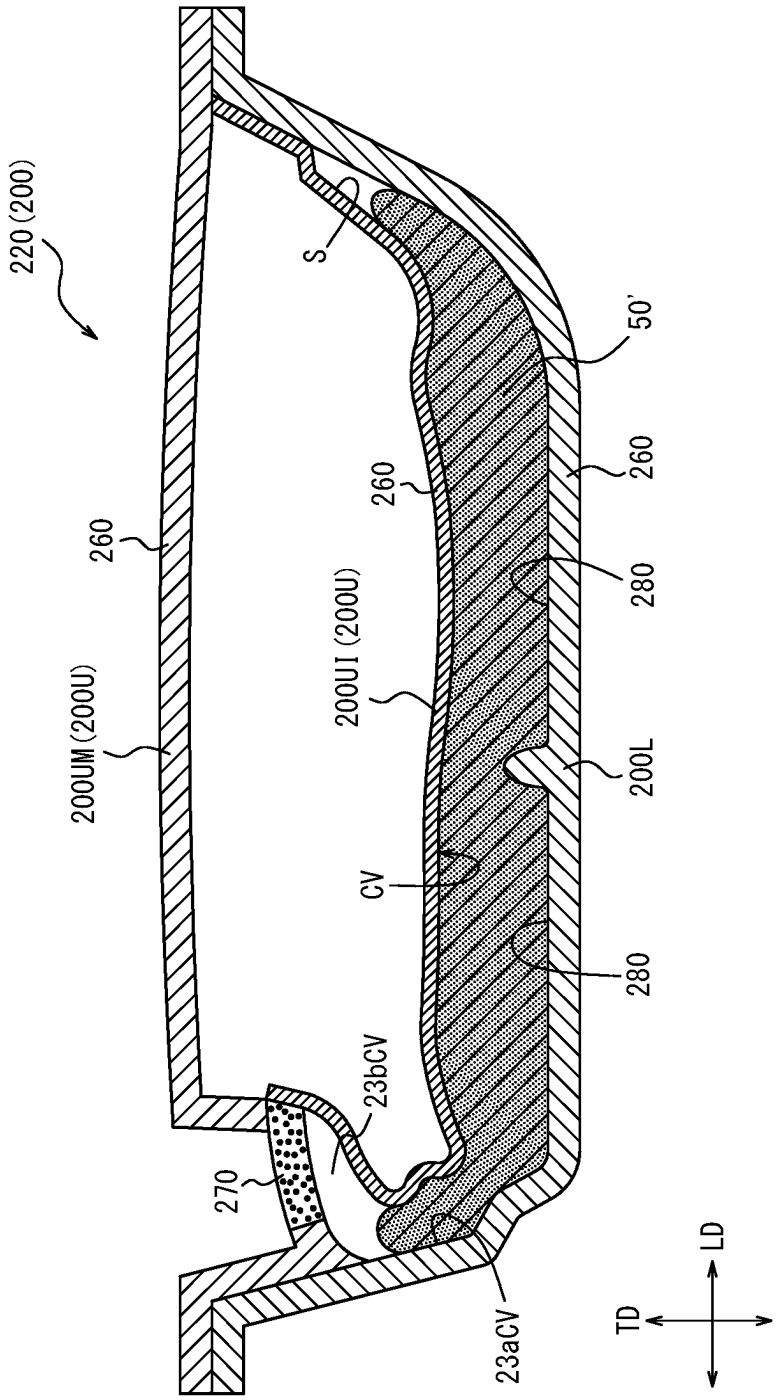

220 (200)
S
50'
260
260
260
280
200UI (200U)
200UM (200U)
200L
CV
280
23bCV
270
23aCV
LD
TD

FIG. 8

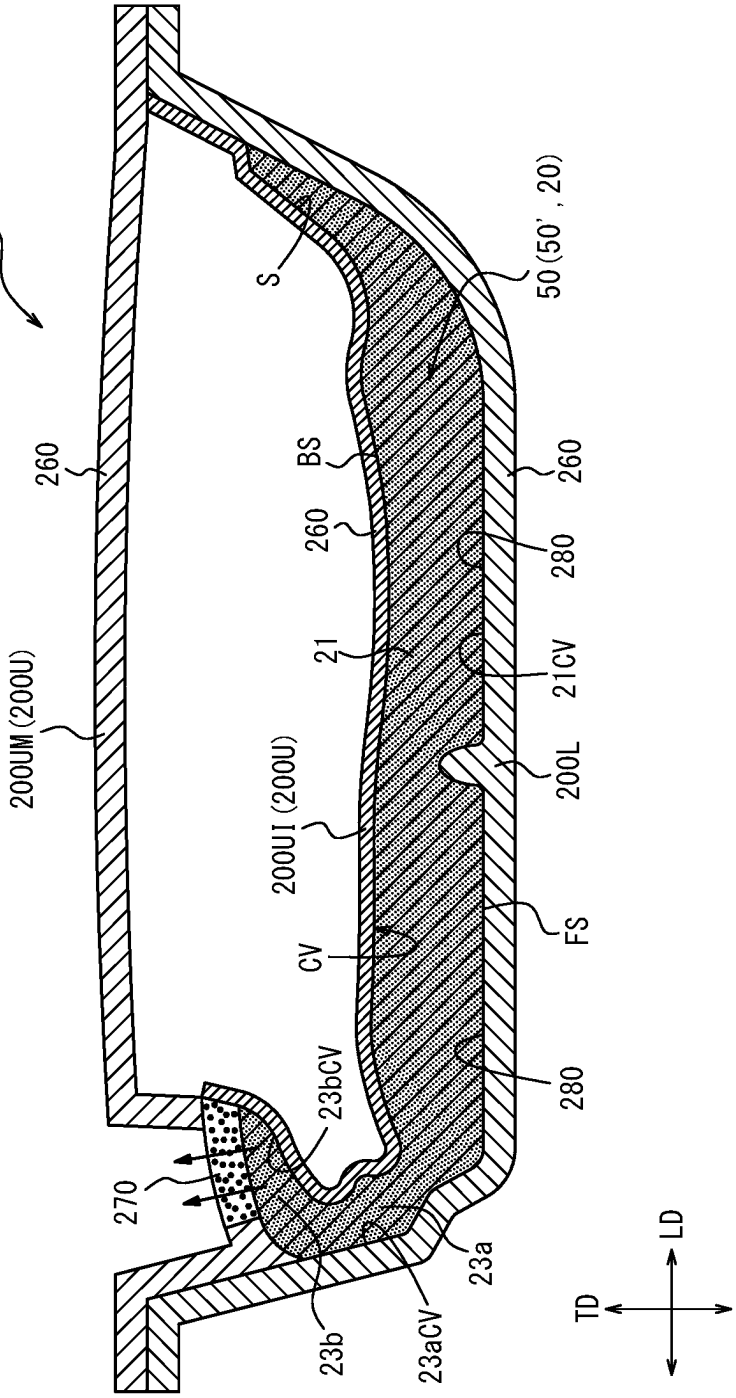

220 (200)
S
50 (50', 20)
260
BS
260
260
280
21
21CV
200UM (200U)
200UI (200U)
200L
FS
CV
23bCV
280
270
23a
23b
23aCV
LD
TD

FIG. 9

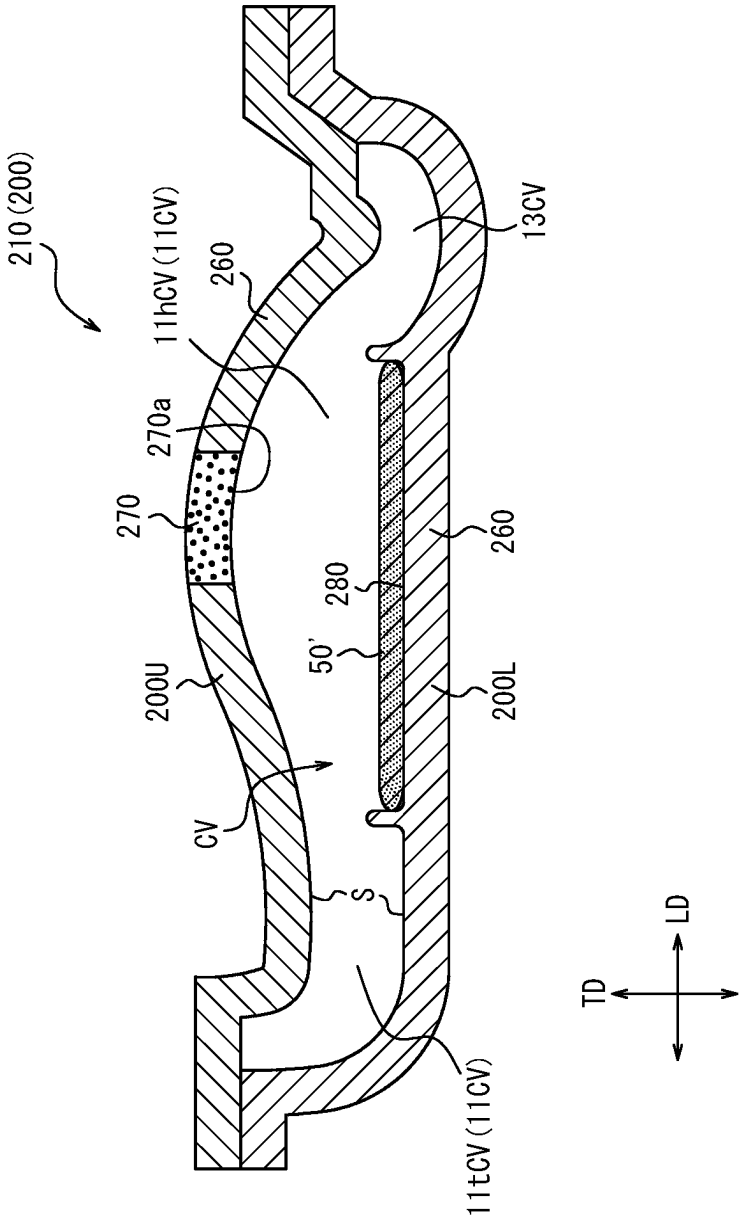

210 (200)
11hCV (11CV)
260
13CV
270a
270
260
280
50'
200U
200L
CV
S
11tCV (11CV)
TD
LD

FIG. 10

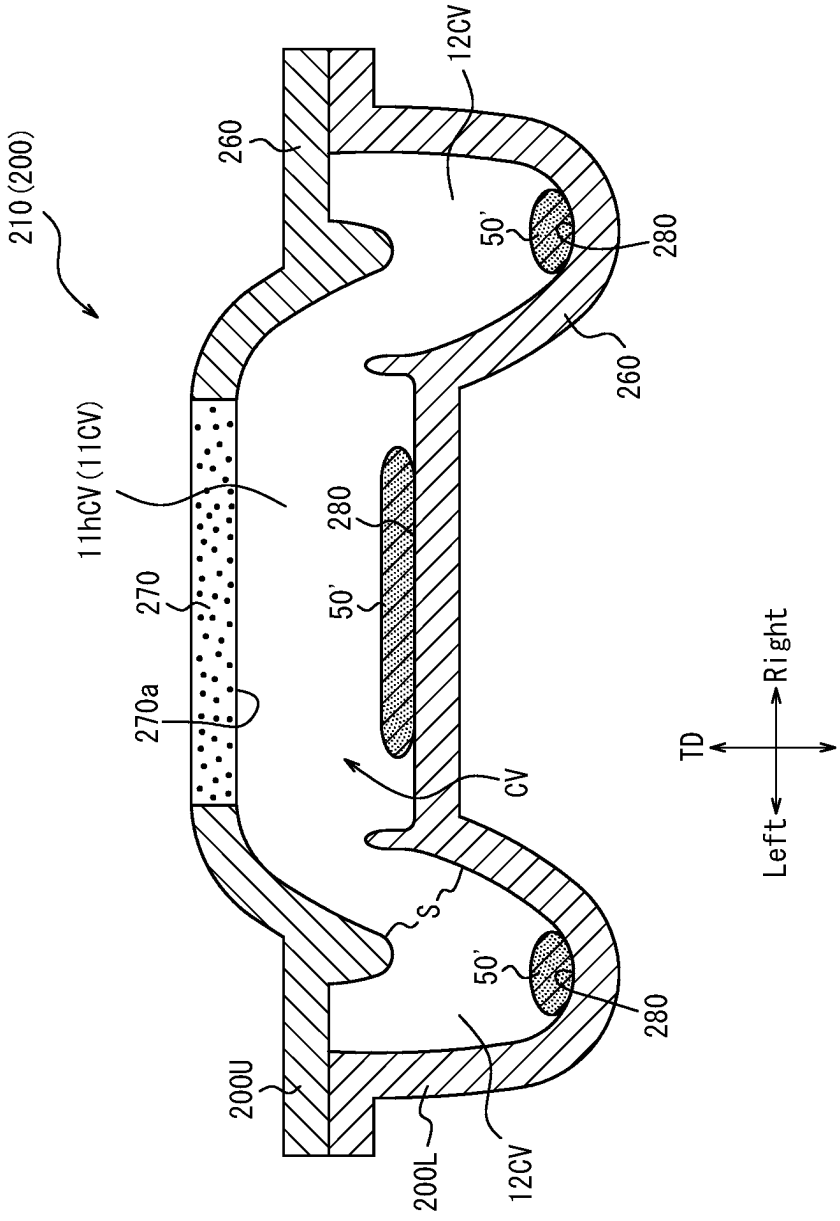

210 (200)
260
12CV
50'
280
260
11hCV (11CV)
270
270a
280
50'
CV
S
50'
280
200U
200L
12CV
TD
Right
Left

FIG. 11

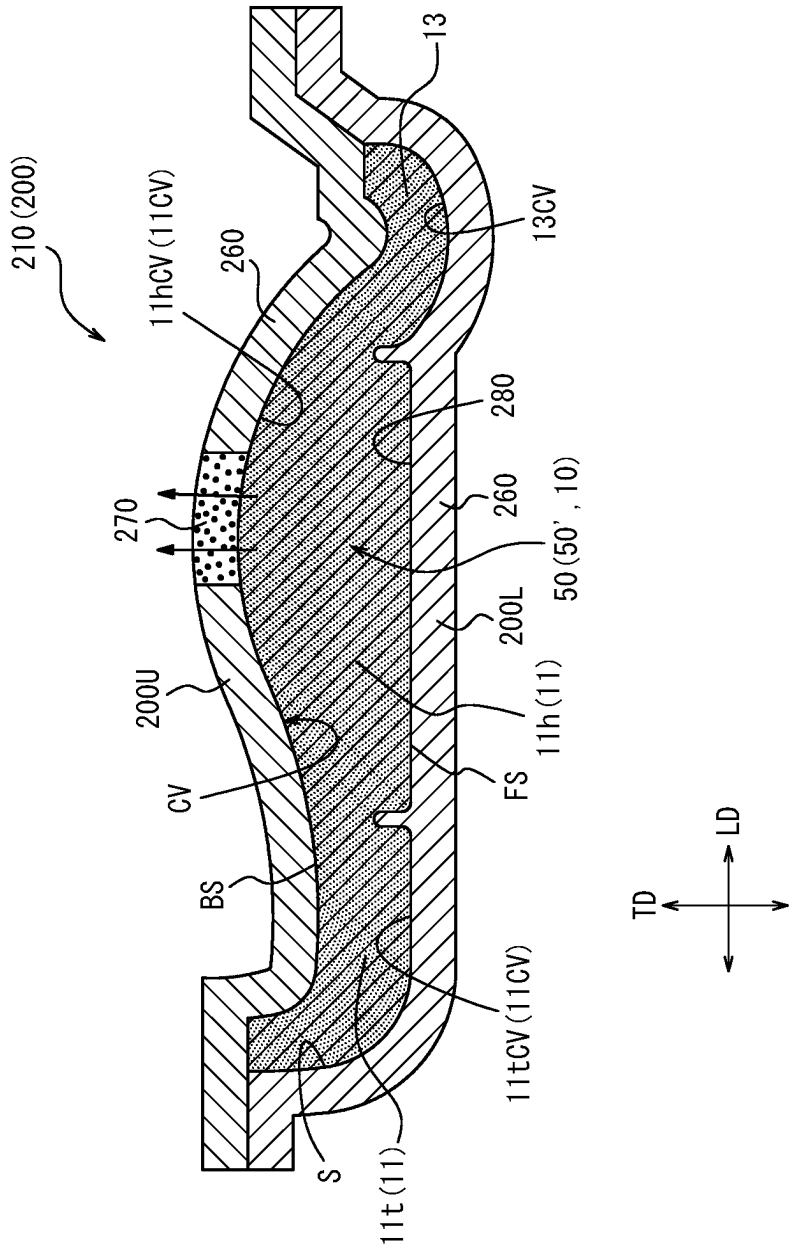

210 (200)
11hCV (11CV)
260
13
13CV
280
260
270
50 (50', 10)
200L
200U
11h (11)
CV
FS
BS
11tCV (11CV)
S
11t (11)
LD
TD

FIG. 12

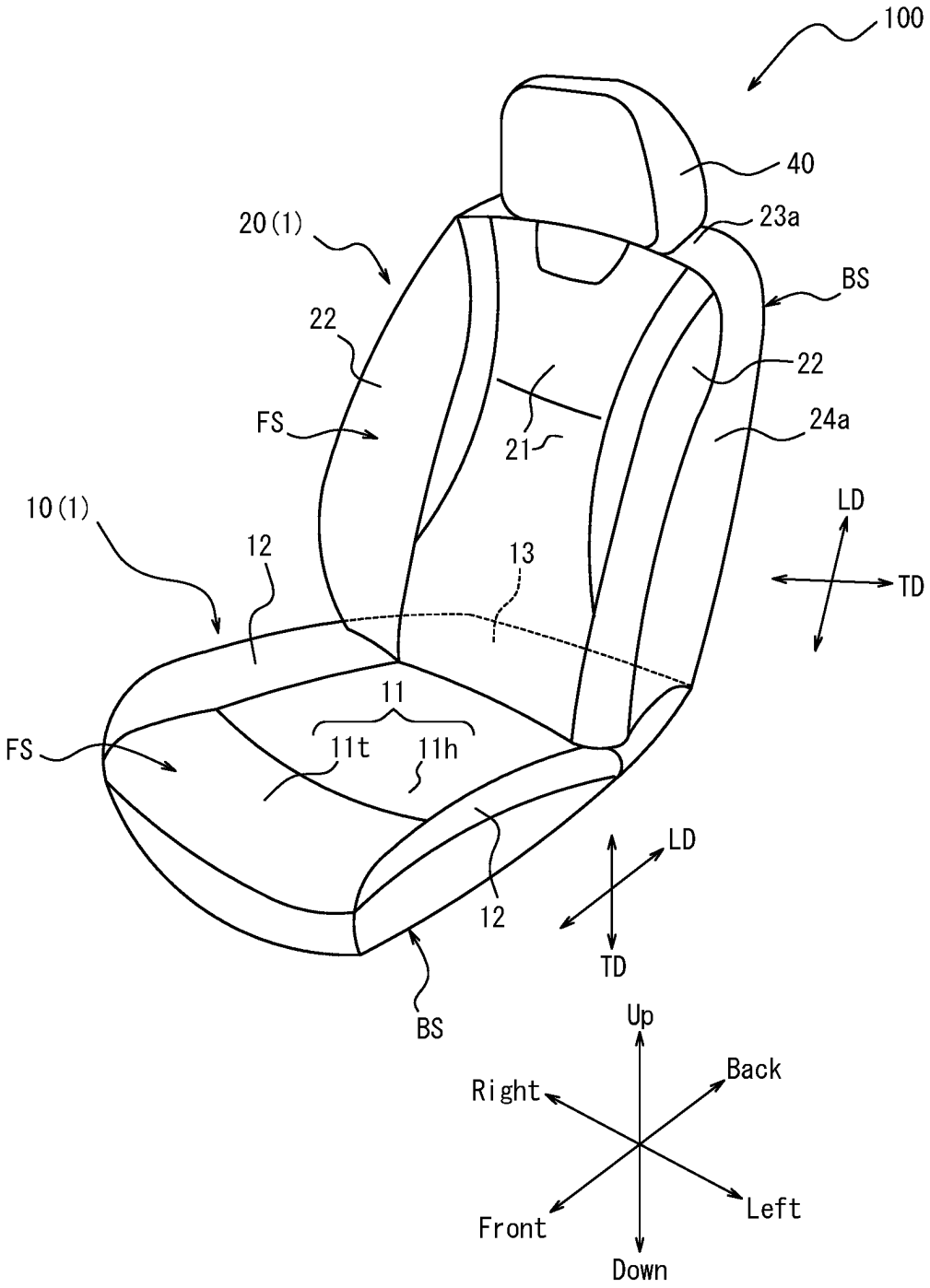
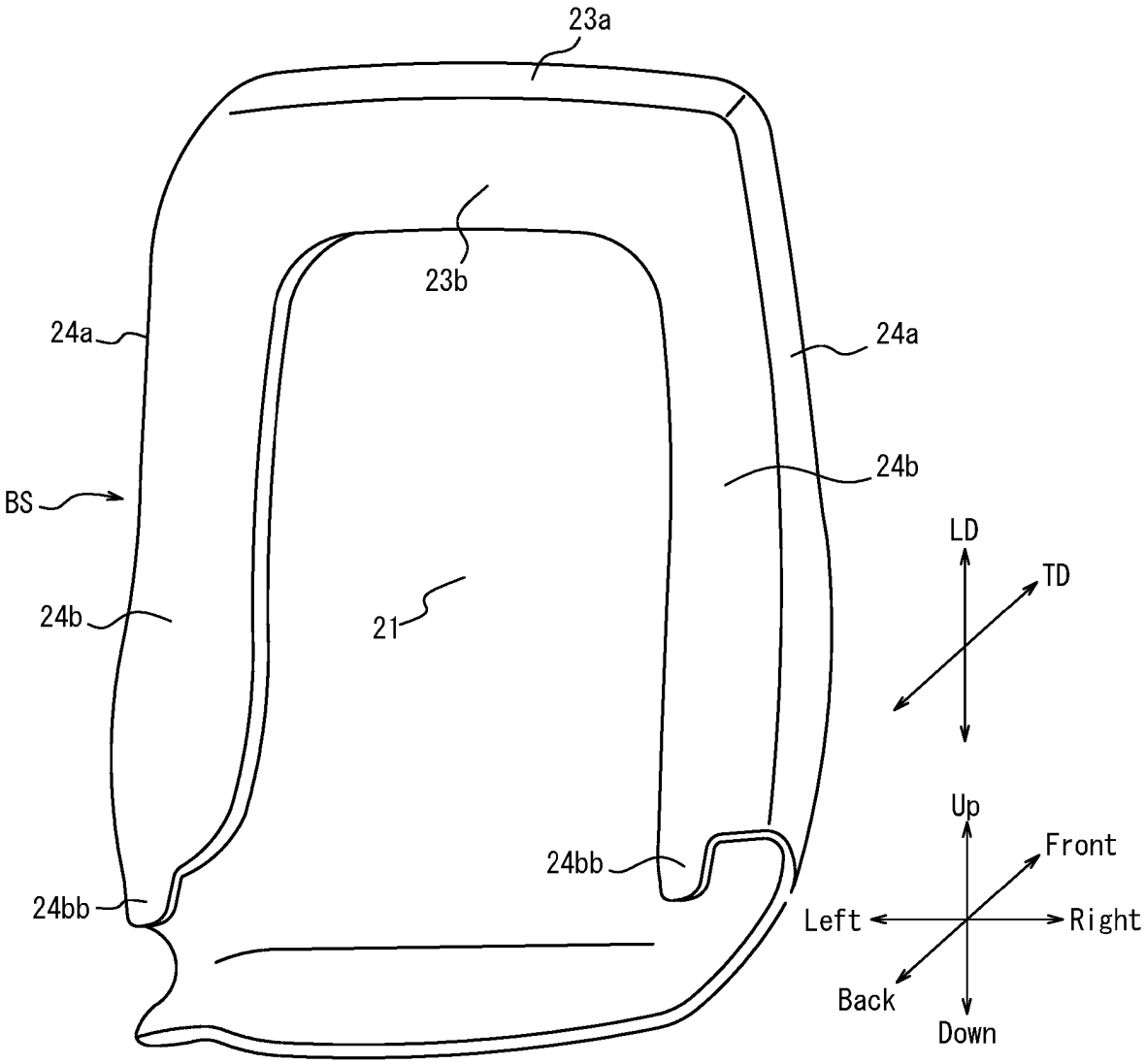

100
40
20(1)
23a
BS
22
22
FS
21
24a
LD
10(1)
12
13
TD
11
FS
11t
11h
LD
12
TD
BS
Up
Back
Right
Left
Front
Down

FIG. 13


23a
23b
24a
24a
24b
BS
24b
21
24bb
24bb
LD
TD
Up
Front
Left
Right
Back
Down

MOLD, DEGASSING TOOL, AND METHOD FOR PRODUCING RESIN FOAM

TECHNICAL FIELD

The present disclosure relates to a mold, a degassing tool, and a method of manufacturing a resin foam body.

The present application is based on and claims the benefit of priority from the Japanese Patent Application No. 2020-197384, filed on Nov. 27, 2020, the entire contents of which are incorporated hereby by reference.

BACKGROUND

Conventionally, there are molds for molding foam bodies that include a mold body portion and a degassing tool (for example, Patent Literature [PTL] 1).

CITATION LIST

Patent Literature

PTL 1: JP 6622571 B2

SUMMARY

Technical Problem

However, in conventional molds, maintenance of the degassing tool may be time-consuming.

It would be helpful to provide a mold, a degassing tool, and a method of manufacturing a resin foam body that can reduce the time required for maintenance of the degassing tool.

Solution to Problem

A mold according to the present disclosure is a mold for molding a foam body, the mold including:

a mold body portion; and

a degassing tool attached to the mold body portion, wherein

the degassing tool is formed of porous metal, and

a surface of the degassing tool that is on a side of a cavity of the mold forms part of a molding surface of the mold.

A degassing tool according to the present disclosure is a degassing tool to be used in the mold, wherein

the degassing tool is formed of porous metal, and

a surface of the degassing tool that is on a side of a cavity of the mold forms part of a molding surface of the mold.

A method of manufacturing a resin foam body according to the present disclosure is a method of manufacturing a resin foam body using the mold, the method including

a foam molding step of foam molding a resin foam body, by arranging a foamable resin material at a predetermined arrangement position in a cavity of the mold and closing the mold, wherein

in the foam molding step, gas in the cavity is released to outside of the mold through the degassing tool.

Advantageous Effect

According to the present disclosure, a mold, a degassing tool, and a method of manufacturing a resin foam body that can reduce the time required for maintenance of the degassing tool can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. **1** is a cross-sectional view illustrating a mold according to a first embodiment of the present disclosure that is configured to mold a back pad of a seat pad along a direction of extension of the back pad;

FIG. **2** is a cross-sectional view illustrating the mold of FIG. **1** along a left and right direction;

FIG. **3** is an enlarged view of part of a degassing tool of FIG. **1**;

FIG. **4** illustrates a mold release agent application step in a method of manufacturing a resin foam body according to an embodiment of the present disclosure, and it depicts a state in the mold of FIG. **1** in which the mold release agent is applied to a degassing tool from the outside;

FIG. **5** illustrates the mold release agent application step in the method of manufacturing a resin foam body according to the embodiment of the present disclosure, and it depicts a state in the mold of FIG. **1** in which the mold release agent has reached a surface of the degassing tool that is on the side of a cavity;

FIG. **6** illustrates a foam molding step in the method of manufacturing a resin foam body according to the embodiment of the present disclosure, and it depicts a state in the mold of FIG. **1** immediately after a foamable resin material is arranged at a predetermined arrangement position and the mold is closed;

FIG. **7** illustrates the foam molding step in the method of manufacturing a resin foam body according to the embodiment of the present disclosure, and it depicts a state in the mold of FIG. **1** in which the cavity is being filled with the foamable resin material;

FIG. **8** illustrates the foam molding step in the method of manufacturing a resin foam body according to the embodiment of the present disclosure, and it depicts a state in the mold of FIG. **1** in which the cavity has been filled with the foamable resin material;

FIG. **9** is a cross-sectional view illustrating a mold according to a second embodiment of the present disclosure that is configured to mold a cushion pad of a seat pad along a direction of extension of the cushion pad, and it depicts a state immediately after a foamable resin material is arranged at a predetermined arrangement position and the mold is closed;

FIG. **10** is a cross-sectional view illustrating the mold of FIG. **9** along the left and right direction, and it depicts a state immediately after the foamable resin material is arranged at the predetermined arrangement position and the mold is closed;

FIG. **11** illustrates a state in the mold of FIG. **9** in which a cavity has been filled with the foamable resin material;

FIG. **12** is a perspective view illustrating an example of a vehicle seat including a seat pad; and

FIG. **13** is a perspective view illustrating a back pad of FIG. **12** from the back side.

DETAILED DESCRIPTION

A mold, a degassing tool, and a method of manufacturing a resin foam body according to the present disclosure are suitable for use in molding any resin foam body, and are more suitable for use in molding a resin foam body made of flexible resin. For example, they are suitable for use in molding a seat pad (especially, a vehicle seat pad). The "flexible resin" refers to resin that can deform when external force is applied, and for example, elastomer-based resin is preferred, and polyurethane is more preferred.

Embodiments of the mold, the degassing tool, and the method of manufacturing a resin foam body according to the present disclosure will be described by way of examples below with reference to the drawings.

In the drawings, the same components are denoted by the same reference numerals.

FIG. **1** to FIG. **8** illustrate a mold **200** and a degassing tool **270** according to a first embodiment of the present disclosure. FIG. **9** to FIG. **11** illustrate a mold **200** and a degassing tool **270** according to a second embodiment of the present disclosure. For convenience of explanation, these embodiments will be described together below.

In each embodiment described herein, the mold **200** is a mold for foam molding, configured to mold a foam body (e.g., resin foam body).

In each embodiment described herein, the mold **200** includes a mold body portion **260** and at least one degassing tool **270**. More specifically, the mold **200** consists of the mold body portion **260** and the at least one degassing tool **270**. The mold body portion **260** corresponds to part of the mold **200** other than the at least one degassing tool **270**.

The degassing tool **270** is attached to the mold body portion **260**. More specifically, the degassing tool **270** is fitted into a hole provided in the mold body portion **260**. Suitable methods of attaching the degassing tool **270** to the mold body portion **260** include fitting by adhesion and/or press-fitting.

The mold body portion **260** is formed of metal.

The degassing tool **270** is formed of porous metal. That is, the degassing tool **270** has a number of cell holes **272** and a skeleton portion **271** that defines these cell holes **272**, as illustrated in an enlarged manner in FIG. **3**. The cell holes **272** are voids. The skeleton portion **271** is formed of metal. The degassing tool **270** has an open-cell structure in which the cell holes **272** communicate with each other. The degassing tool **270** is configured to allow gas to pass through the cell holes **272**, thereby allowing gas in a cavity CV to be released to the outside of the mold **200**.

The mold **200** has a molding surface S configured to mold a foam body (e.g., resin foam body). The molding surface S defines the cavity CV.

A surface **270***a* of the degassing tool **270** that is on the side of the cavity CV forms part of the molding surface S of the mold **200**, i.e., it faces the cavity CV.

The mold **200** may be configured to mold any resin foam body, and it is preferably configured to mold a resin foam body made of flexible resin. For example, it is preferably configured to mold a resin foam body made of polyurethane foam. The mold **200** may also be configured to mold a foam body for any application, and for example, it may be configured to mold a seat pad. The mold **200** of FIG. **1** to FIG. **8** according to the first embodiment is configured as a back pad molding mold **220**, which is configured to mold a back pad **20** in a seat pad (i.e., vehicle seat pad) **1** to be used in a vehicle seat **100** as illustrated in FIG. **12**. The mold **200** of FIG. **9** to FIG. **11** according to the second embodiment is configured as a cushion pad molding mold **210**, which is configured to mold a cushion pad **10** in the seat pad (i.e., vehicle seat pad) **1** to be used in the vehicle seat **100** as illustrated in FIG. **12**.

Now, the seat pad **1** will be described with reference to FIG. **12** and FIG. **13**.

The seat pad **1** includes a cushion pad **10** for a seated person to sit on and a back pad **20** for supporting the back of the seated person. FIG. **13** illustrates the back pad **20** viewed from a back surface BS side. Each of the cushion pad **10** and the back pad **20** forms the seat pad **1**. In the following, the cushion pad **10** or the back pad **20** may be referred to simply as the "seat pad **1**." In addition to the seat pad **1**, the vehicle seat **100** includes, for example, a skin (not illustrated) that covers a front side (seated person's side) of the seat pad **1**, a frame (not illustrated) that supports the cushion pad **10** from below, a frame (not illustrated) installed on the back side of the back pad **20**, and a headrest **40** installed on the upper side of the back pad so as to support the head of the seated person. The skin is formed of, for example, a breathable material (e.g., fabric). Although in the example of FIG. **1** the cushion pad **10** and the back pad **20** are configured as separate components, they may be configured as a single component.

Furthermore, although in the example of FIG. **12** the headrest **40** and the back pad **20** are configured as separate components, the headrest **40**, together with the back pad **20**, may be configured as a single component.

As illustrated in FIG. **12**, the cushion pad **10** includes a main pad (also referred to as a "seated portion") **11** configured to support the hips and thighs of a seated person from below, a pair of side pads **12** that are positioned on both left and right sides of the main pad **11** and are configured to bulge upward from the main pad **11** so as to support the seated person from both the left and right sides, and a back pad facing portion **13** that is positioned behind the main pad **11** and that is configured to be arranged to face the back pad **20** in an up and down direction. The main pad **11** has an under-thigh portion **11***t*, which is configured to support the thighs of the seated person from below, and an under-hip portion **11***h*, which is positioned behind the under-thigh portion **11***t* and configured to support the hips of the seated person from below.

As illustrated in FIG. **12** and FIG. **13**, the back pad **20** includes a main pad **21** configured to support the back of the seated person from behind, a pair of side pads **22** that are positioned on both left and right sides of the main pad **21** and that are configured to bulge forward from the main pad **21** so as to support the seated person from both the left and right sides, an upper bridge portion **23***a* extending backward from an upper end of the main pad **21**, an upper back portion **23***b* extending downward from a back end of the upper bridge portion **23***a*, a pair of side bridge portions **24***a* extending backward from outer ends in the left and right direction of the pair of side pads **22**, and a pair of side back portions **24***b* extending inward in the left and right direction from back ends of the pair of side bridge portions **24***a*. The upper back portion **23***b* is spaced apart backward from the main pad **21**. The upper bridge portion **23***a* connects the main pad **21** and the upper back portion **23***b*. The pair of side back portions **24***b* is spaced apart backward from the pair of side pads **22**. The pair of side bridge portions **24***a* connects the pair of side pads **22** and the pair of side back portions **24***b*. Although not illustrated, a frame is fitted between the main pad **21** and the upper back portion **23***b*, and between the pair of side pads **22** and the pair of side back portions **24***b*.

Herein, the directions "up," "down," "left," "right," "front," and "back" as viewed from a seated person sitting on the vehicle seat **100** are simply referred to as, for example, "up," "down," "left," "right," "front," and "back," respectively.

Furthermore, herein, a "direction of extension (LD) of the seat pad **1**" (hereinafter simply referred to as the "direction of extension [LD]") refers to a direction perpendicular to the left and right direction and a thickness direction (TD) of the seat pad **1**. As illustrated in FIG. **12**, in the case of the cushion pad **10**, it refers to a front and back direction, and in the case of the back pad **20**, it refers to a direction in which the main pad **21** of the back pad **20** extends from a lower surface to an upper surface of the main pad **21**.

The "thickness direction (TD) of the seat pad **1**" (hereinafter simply referred to as the "thickness direction [TD]") refers to the up and down direction in the case of the cushion pad **10**, and in the case of the back pad it refers to a direction in which the main pad **21** of the back pad **20** extends from a surface on the seated person's side (front surface) FS to the back surface BS of the main pad **21**, as illustrated in FIG. **12**.

The "surface on the seated person's side (front surface or FS)" of the seat pad **1** refers to an upper surface in the case of the cushion pad **10**, and it refers to a front surface in the case of the back pad **20**. The "back surface (BS)" of the seat pad **1** refers to a lower surface in the case of the cushion pad **10**, and it refers to a back surface in the case of the back pad **20**.

Next, with reference to FIG. **1**, FIG. **2**, and FIG. **8**, the mold **200** according to the first embodiment of the present disclosure (i.e., back pad molding mold **220**) will be described in more detail. As described above, the mold **200** according to the first embodiment is configured as the back pad molding mold **220**, which is configured to mold the back pad **20** (FIG. **12**). For convenience, in FIG. **1**, FIG. **2**, and FIG. **8**, the direction of extension LD, the thickness direction TD, and the left and right direction in the back pad **20**, which is a resin foam body **50** (FIG. **8**) to be molded by the mold **200**, are indicated by arrows. FIG. **1** is a cross-sectional view illustrating the mold **200** along the direction of extension LD of the back pad **20**, and FIG. **2** is a cross-sectional view illustrating the mold **200** along the left and right direction of the back pad **20**.

In the first embodiment, the mold **200** includes an upper mold **200**U and a lower mold **200**L arranged below the upper mold **200**U. The upper mold **200**U has an upper mold body portion **200**UM and a core **200**UI. As illustrated in FIG. **8**, the molding surface S of the upper mold **200**U is configured to mold part of the surface of the back pad **20** that includes the back surface BS. The molding surface S of the lower mold **200**L is configured to mold part of the surface of the back pad **20** that includes the surface FS on the seated person's side. When the mold **200** is closed by joining the upper mold **200**U and the lower mold **200**L, the cavity CV is defined in the mold **200**.

In the first embodiment, the cavity CV includes a main pad molding cavity **21**CV (FIG. **1**, FIG. **2**, and FIG. **8**) configured to mold the main pad **21**, a pair of side pad molding cavities **22**CV (FIG. **2**) configured to mold the pair of side pads **22**, an upper bridge portion molding cavity **23***a*CV (FIG. **1** and FIG. **8**) configured to mold the upper bridge portion **23***a*, an upper back portion molding cavity **23***b*CV (FIG. **1** and FIG. **8**) configured to mold the upper back portion **23***b*, a pair of side bridge portion molding cavities **24***a*CV (FIG. **2**) configured to mold the pair of side bridge portions **24***a*, and a pair of side back portion molding cavities **24***b*CV (FIG. **2**) configured to mold the pair of side back portions **24***b*.

In the first embodiment, the degassing tool **270** forms part of the upper mold **200**U. The mold body portion **260** forms the upper mold **200**U except for the above part and the lower mold **200**L. More specifically, in the example illustrated in the figures, the degassing tool **270** forms at least part of a portion of the upper mold **200**U (specifically, the upper mold body portion **200**UM) that faces the upper back portion molding cavity **23***b*CV, as illustrated in FIG. **1**. However, the degassing tool **270** may form any part of the mold **200** (the upper mold **200**U and/or the lower mold **200**L). For example, although not illustrated, it is preferable for another pair of degassing tools **270**, in addition to the degassing tool **270** of FIG. **1**, to form at least part of the portion of the upper mold **200**U that faces the pair of side back portion molding cavities **24***b*CV (in particular, a portion thereof that faces part of the pair of side back portion molding cavities **24***b*CV configured to mold lower ends **24***bb* [FIG. **13**] of the side back portions **24***b*). The degassing tool **270** may also from part of the lower mold **200**L.

Next, with reference to FIG. **9** to FIG. **11**, a configuration of the mold **200** according to the second embodiment of the present disclosure will be described. As described above, in the second embodiment, the mold **200** is configured as the cushion pad molding mold **210**, which is configured to mold the cushion pad **10** (FIG. **12**). For convenience, in FIG. **9** to FIG. **11**, the direction of extension LD, the thickness direction TD, and the left and right direction in the cushion pad **10**, which is a resin foam body **50** (FIG. **11**) to be molded by the mold **200**, are indicated by arrows. FIG. **9** is a cross-sectional view illustrating the mold **200** along the direction of extension LD of the cushion pad **10**, and FIG. **10** is a cross-sectional view illustrating the mold **200** along the left and right direction of the cushion pad **10**.

In the second embodiment, the mold **200** includes an upper mold **200**U and a lower mold **200**L arranged below the upper mold **200**U. As illustrated in FIG. **11**, the molding surface S of the upper mold **200**U is configured to mold part of the surface of the cushion pad **10** that includes the back surface BS. The molding surface S of the lower mold **200**L is configured to mold part of the surface of the cushion pad **10** that includes the surface FS on the seated person's side. When the mold **200** is closed by joining the upper mold **200**U and the lower mold **200**L, the cavity CV is defined in the mold **200**.

In the second embodiment, the cavity CV includes a main pad molding cavity **11**CV (FIG. **9** to FIG. **11**) configured to mold the main pad **11**, a pair of side pad molding cavities **12**CV (FIG. **10**) configured to mold the pair of side pads **12**, and a back pad facing portion molding cavity **13**CV (FIG. **10**) configured to mold the back pad facing portion **13**. The main pad molding cavity **11**CV has an under-thigh portion molding cavity **11***t*CV (FIG. **9** and FIG. **11**) configured to mold the under-thigh portion **11***t*, and an under-hip portion molding cavity **11***h*CV (FIG. **9** to FIG. **11**) configured to mold the under-hip portion **11***h*.

In the second embodiment, the degassing tool **270** forms part of the upper mold **200**U. The mold body portion **260** forms the upper mold **200**U except for the above part and the lower mold **200**L. More specifically, in the example illustrated in the figures, the degassing tool **270** forms at least part of a portion of the upper mold **200**U that faces the under-hip portion molding cavity **11***h*CV. However, the

degassing tool **270** may form any part in the mold **200**. For example, the degassing tool **270** may form part of the lower mold **200**L.

Next, with reference to FIG. **4** to FIG. **8**, the method of manufacturing a resin foam body according to an embodiment of the present disclosure will be described. Although FIG. **4** to FIG. **8** illustrate a case in which the mold **200** (and thus, the back pack molding mold **220**) according to the first embodiment of the present disclosure described above is used, the method of manufacturing a resin foam body according to the present embodiment can be implemented in the same manner using the mold **200** according to any embodiment of the present disclosure.

The method of manufacturing a resin foam body according to the present embodiment includes a mold release agent application step and a foam molding step.

First, in the mold release agent application step, a mold release agent **60** is applied to the molding surface S of the mold **200**. The mold release agent application step is performed before the foam molding step.

The mold release agent **60** is preferably applied to the entire molding surface S of the mold **200**, but it may be applied to only part of the molding surface S.

In the mold release agent application step, preferably, the mold release agent **60** is also applied to the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV and that forms part of the molding surface S. In this case, as illustrated in FIG. **4** and FIG. **5**, the mold release agent **60** may be applied to the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV, by allowing the mold release agent **60** to permeate the degassing tool **70** from outside the mold **200** and reach the surface **270***a* of the degassing tool **70** that is on the side of the cavity CV. This allows easy application of the mold release agent **60** to the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV, even when the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV is located where it is difficult to apply the mold release agent **60** from the cavity CV side, as in the examples in FIG. **4** and FIG. **5**. FIG. **4** illustrates a state in which the mold release agent is applied to the degassing tool from the outside. FIG. **5** illustrates a state in which the mold release agent **60** has reached the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV. The mold release agent **60** may, however, be applied to the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV from the cavity CV side.

It is, however, not essential to apply the mold release agent **60** to the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV in the mold release agent application step.

The mold release agent is, for example, a solvent-based agent.

Next, in the foam molding step, a foamable resin material **50'** is arranged at a predetermined arrangement position **280** in the cavity CV of the mold **200**, the mold **200** is closed, and a resin foam body **50** is foam molded (FIG. **6** to FIG. **8**). The foamable resin material **50'** is in a liquid form.

FIG. **6** illustrates a state immediately after the foamable resin material **50'** is arranged at the predetermined arrangement position **280** and the mold **200** is closed. FIG. **7** illustrates a state in which the cavity CV is being filled with the foamable resin material **50'**. FIG. **8** illustrates a state in which the cavity CV has been filled with the foamable resin material **50'**.

The predetermined arrangement position **280** is a predetermined position at which the foamable resin material **50'** is to be arranged. In the examples of FIG. **1** to FIG. **8**, the predetermined arrangement position **280** corresponds to part of the molding surface S of the lower mold **200**L that faces the middle portion in the left and right direction of the main pad molding cavity **21**CV and part of the molding surface S of the lower mold **200**L that faces part of the pair of side pad molding cavities **22**CV (FIG. **2** and FIG. **6**). In the examples of FIG. **9** to FIG. **11**, the predetermined arrangement position **280** corresponds to part of the molding surface S of the lower mold **200**L that faces the middle portion in the left and right direction of the main pad molding cavity **11**CV and part of the molding surface S of the lower mold **200**L that faces part of the pair of side pad molding cavities **12**CV (FIG. **9** and FIG. **10**). The predetermined arrangement position **280** may, however, be any position in the cavity CV of the mold **200**. There may be only one or several predetermined arrangement positions **280**. The predetermined arrangement position **280** is preferably located on at least part of the molding surface S of the lower mold **200**L, because this makes it easy to arrange the foamable resin material **50'**.

The foamable resin material **50'** arranged at the predetermined arrangement position **280** gradually expands and starts to fill the cavity CV, and then is molded into the resin foam body **50** having a shape corresponding to the cavity CV (FIG. **7** and FIG. **8**).

In the foam molding step, gases in the cavity CV (a gas present in the cavity CV and a gas generated by the reaction of the foamable resin material **50'**) are released to the outside of the mold **200** through the degassing tool **270** (FIG. **8**). This can prevent excess bubbles from remaining in the resin foam body **50**, and thus preventing the occurrence of defects, such as insufficient filling, in the resin foam body **50**.

After the foam molding step, the mold **200** is opened, and the resin foam body **50** is removed so as to obtain the resin foam body **50**.

Additionally, the mold release agent application step may be omitted.

In each embodiment described herein, as described above, the degassing tool **270** is formed of porous metal, and the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV forms part of the molding surface S of the mold **200**. Thus, because the degassing tool **270** has a simple structure, compared to a case in which a degassing tool has a complex structure as in PTL 1, the risk of the foamable resin material **50'** being trapped or entering the degassing tool **270** during foam molding can be reduced, and thus, the time required for maintenance of the degassing tool **270** can be reduced, and the defective rate of resin foam bodies **50** can be reduced.

According to each embodiment described herein, since the degassing tool **270** is formed of porous metal, the entire surface **270***a* on the side of the cavity CV has the function of releasing gases in the cavity CV to the outside of the mold **200**. Accordingly, compared to a case in which only part of a degassing tool provides the function of releasing gases in the cavity CV to the outside of the mold **200** as in PTL 1, it can be further ensured that excess bubbles are prevented from remaining in the resin foam body **50**, and thus, the occurrence of defects, such as insufficient filling, in the resin foam body **50** can be prevented. Additionally, in the degassing tool according to PTL 1, only an outer peripheral part of an opening and closing portion facing a cavity provides the function of releasing gases in the cavity to the outside of the mold, and part thereof directly below the opening and closing portion does not have the function of releasing gases

in the cavity to the outside of the mold, so there is a possibility that excess bubbles may remain in a resin foam body.

According to each embodiment described herein, since the degassing tool **270** is formed of porous metal, and the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV forms part of the molding surface S of the mold **200**, the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV can be formed in any surface shape (e.g., curved surface shape) and can more smoothly follow the surface shape (design shape) of a desired resin foam body **50**. In this regard, in PTL 1, the opening and closing portion of the degassing tool has a flat plate shape, and it is difficult to follow the surface shape (design shape) of a desired resin foam body, so that marks of the opening and closing portion may be left on the resin foam body.

According to each embodiment described herein, since the degassing tool **270** is formed of metal, clogging, softening, or the like of the degassing tool **270** due to erosion of the degassing tool **270** by, for example, a solvent-based mold release agent **60** can be better prevented, compared to a case in which the degassing tool **270** is formed of resin or the like. Furthermore, since the degassing tool **270** is formed of metal, the difference in thermal expansion coefficient between the mold body portion **260** and the degassing tool **270** can be reduced. This in turn prevents a gap from forming between the mold body portion **260** and the degassing tool **270** during foam molding, thereby preventing the foamable resin material **50'** from leaking out of the mold **200** from the gap. Moreover, since the degassing tool **270** is formed of metal, it is easier to maintain a uniform temperature of the mold **200**, which in turn makes it easier to make the density distribution of the resin foam body **50** uniform. Moreover, since the degassing tool **270** is formed of metal, the surface conditions (skin, or apparent shininess, surface air permeability, or the like.) of a surface portion of the resin foam body **50** molded by the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV and the surface conditions of a surface portion of the resin foam body **50** molded by the molding surface S of the mold body portion **260** can be made the same.

In the following, preferable configurations of the mold **200** and modifications will be described. Regarding each of the configurations described below, in a case in which the mold **200** includes a plurality of degassing tools **270**, only some (one or more) of the degassing tools **270** may satisfy the configuration, or all of the degassing tools **270** may satisfy the configuration.

In each embodiment described herein, preferably, there is no step between the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV and part of the mold body portion **260** that is adjacent to the degassing tool **270**, as in the examples of FIG. **1** and FIG. **9**. This prevents marks of the degassing tool **270** from remaining on the resin foam body **50**.

In each embodiment described herein, the degassing tool **270** (specifically, the cell holes **272** of the degassing tool **270**) is preferably configured to allow gases in the cavity CV, but not the foamable resin material **50'** arranged in the cavity CV, to pass therethrough. This can prevent the foamable resin material **50'** from entering the cell holes **272** of the degassing tool **270** during foam molding, and thus, the time required for maintenance of the degassing tool **270** can be reduced, and the defective rate of resin foam bodies **50** can be reduced.

In each embodiment described herein, the degassing tool **270** may be formed of any metal. For example, the degassing tool **270** is preferably formed of metal that is composed mainly of, for example, iron, aluminum, or nickel. In this case, the difference in thermal expansion coefficient between the mold body portion **260** and the degassing tool **270** can be further reduced. This in turn more effectively prevents a gap from forming between the mold body portion **260** and the degassing tool **270** during foam molding.

In this case, it is preferable for the mold body portion **260** to be formed of metal that is composed mainly of aluminum or iron.

Examples of metal that is composed mainly of iron include iron, stainless steel, and maraging steel. Examples of metal that is composed mainly of aluminum include aluminum and aluminum alloy. Examples of metal that is composed mainly of nickel include nickel and nickel alloy.

In each embodiment described herein, the difference in linear expansion coefficient between the metal of which the mold body portion **260** is formed and the metal of which the degassing tool **270** is formed is preferably 15×10^{-6}/K or less, and more preferably 12×10^{-6}/K or less.

This more effectively prevents a gap from forming between the mold body portion **260** and the degassing tool **270** during foam molding.

The linear expansion coefficient of the metal is measured in accordance with JIS Z 2285:2003.

In each embodiment described herein, at least part of the degassing tool **270** preferably extends over the entirety in a thickness direction of the mold **200**, as in the examples of FIG. **1** and FIG. **9**. This allows the degassing tool **270** to effectively release gases in the cavity CV to the outside of the mold **200**.

However, the degassing tool **270** may have its one side opposite to the cavity CV covered by the mold body portion **260**. In that case, part of the mold body portion **260** that covers the degassing tool **270** may be provided with one or more vent holes that penetrate the part in the thickness direction of the mold **200**. In this case, gases in the cavity CV are released to the outside of the mold **200** through the vent holes after passing through the degassing tool **270**.

Additionally, the mold body portion **260** may include one or more vent holes that penetrate the mold **200** in the thickness direction in positions at a distance from the degassing tool **270**.

In each embodiment described herein, the degassing tool **270** is preferably arranged at a distance from the predetermined arrangement position **280** of the foamable resin material **50'**, as in the examples of FIG. **1** through FIG. **11**. During foam molding, the foamable resin material **50'** starts to fill the cavity CV while gradually expanding, but as it progresses further away from the predetermined arrangement position **280**, it takes longer to fill and a large number of bubbles tend to be entrapped. By arranging the degassing tool **270** in a position at a distance from the predetermined arrangement position **280** where such bubbles are likely to form, these excess bubbles can be effectively removed by the degassing tool **270**. It is therefore possible to effectively prevent excess bubbles from remaining in the resin foam body **50**.

In each embodiment described herein, in a case in which the mold **200** includes the upper mold **200**U and the lower mold **200**L, as in the examples of FIG. **1** through FIG. **11**, it is preferable for the degassing tool **270** to form part of the upper mold **200**U. In this case, the predetermined arrangement position **280** of the foamable resin material **50'** is preferably in at least part of the molding surface S of the lower mold **200**L. In this case, during foam molding, the foamable resin material **50'** gradually expands, and filling

starts from the molding surface S of the lower mold **200**L and progresses toward the upper side, but as it progresses further away from the predetermined arrangement position **280** (and thus closer to the upper side), it takes longer to fill and a large number of bubbles tend to be entrapped. By arranging the degassing tool **270** at an upper position where such bubbles are likely to form, these excess bubbles can be effectively removed by the degassing tool **270**. It is therefore possible to effectively prevent excess bubbles from remaining in the resin foam body **50**.

In a case in which the upper mold **200**U includes the upper mold body portion **200**UM and the core **200**UI, as in the examples of FIG. **1** and FIG. **2**, the degassing tool **270** may form part of the upper mold body portion **200**UM and/or the core **200**UI.

As described above, however, the degassing tool **270** may form any part of the mold **200**. Furthermore, the mold **200** may have any configuration, without being limited to the configuration with the upper mold **200**U and the lower mold **200**L.

In each embodiment described herein, as in the examples of FIG. **1** to FIG. **8**, it is preferable for the degassing tool **270** to face a position in the cavity CV (in the examples of FIG. **1** to FIG. **8**, the upper back portion molding cavity **23***b*CV) where the foamable resin material **50'**, which is arranged at the predetermined arrangement position **280** in the cavity CV, reaches last. By thus arranging the degassing tool **270** at a position farthest from the predetermined arrangement position **280** where bubbles are most likely to form, excess bubbles can be effectively removed by the degassing tool **270**. It is therefore possible to effectively prevent excess bubbles from remaining in the resin foam body **50**.

In each embodiment described herein, it is preferable for the degassing tool **270** to be manufactured using a 3D printer. Although the powder sintering method is preferably used as a shaping method using a 3D printer, other methods may be employed. The powder sintering method is based on sintering of metal powders by irradiating them with a laser beam.

By manufacturing the degassing tool **270** using a 3D printer, the porous structure of the degassing tool **270** can be easily obtained as desired, and a desired degassing function can be achieved.

In each embodiment described herein, the degassing tool **270** may have any porous structure. For example, the degassing tool **270** may be configured in a grid form, as in the example of FIG. **3**. In this case, the cell holes **272** of the degassing tool **270** are regularly arranged, specifically, arranged with equal spacing along two mutually orthogonal directions. Alternatively, the cell holes **272** of the degassing tool **270** may be randomly arranged.

The cell holes **272** of the degassing tool **270** preferably have a substantially uniform diameter. The cell holes **272** of the degassing tool **270** preferably have a substantially uniform shape.

In each embodiment described herein, from the viewpoint of improving the degassing function, the surface **270***a* of the degassing tool **270** that is on the side of the cavity CV has an area of preferably 9 cm^2 or more, and preferably 25 cm^2 or more. The surface **270***a* of the degassing tool **270** that is on the side of the cavity CV has an area of preferably 150 cm^2 or less, and preferably 110 cm^2 or less.

INDUSTRIAL APPLICABILITY

The mold, the degassing tool, and the method of manufacturing a resin foam body are suitable for use in molding any resin foam body, and are more suitable for use in molding a resin foam body made of flexible resin. For example, they are suitable for use in molding a seat pad (in particular, a vehicle seat pad).

REFERENCE SIGNS LIST

200 Mold
200L Lower mold
LS Molding surface of lower mold
200U Upper mold
US Molding surface of upper mold
200UM Upper mold body portion
200UI Core
S Molding surface
CV Cavity
210 Cushion pad molding mold
11CV Main pad molding cavity
11*t*CV Under-thigh portion molding cavity
11*h*CV Under-hip portion molding cavity
12CV Side pad molding cavity
13CV Back pad facing portion molding cavity
220 Back pad molding mold
21CV Main pad molding cavity
22CV Side pad molding cavity
23*a*CV Upper bridge portion molding cavity
23*b*CV Upper back portion molding cavity
24*a*CV Side bridge portion molding cavity
24*b*CV Side back portion molding cavity
260 Mold body portion
270 Degassing tool
270*a* Surface that is on the side of cavity
271 Skeleton portion
272 Cell hole
280 Predetermined arrangement position
50 Resin foam body
50' Foamable resin material
60 Mold release agent
1 Seat pad
10 Cushion pad
11 Main pad (seated portion)
11*t* Under-thigh portion
11*h* Under-hip portion
12 Side pad
13 Back pad facing portion
20 Back pad
21 Main pad
22 Side pad
23*a* Upper bridge portion
23*b* Upper back portion
24*a* Side bridge portion
24*b* Side back portion
24*bb* Lower end
40 Headrest
100 Vehicle seat
TD Thickness direction
LD Direction of extension
FS Surface on seated person's side (front surface)
BS Back surface

The invention claimed is:

1. A mold comprising:
a mold body portion; and
a degassing tool attached to the mold body portion, wherein
the degassing tool is formed of porous metal,

a surface of the degassing tool that is on a side of a cavity of the mold forms part of a molding surface of the mold, and

a mold release agent is permeated through the degassing tool and applied to the surface of the degassing tool that is on the side of the cavity.

2. The mold according to claim **1**, wherein the degassing tool is formed of metal that is composed mainly of iron, aluminum, or nickel.

3. The mold according to claim **1**, wherein a difference in linear expansion coefficient between a metal of which the mold body portion is formed and a metal of which the degassing tool is formed is 15×10^{-6}/K or less.

4. The mold according to claim **1**, wherein the degassing tool extends over an entirety in a thickness direction of the mold.

5. The mold according to claim **1**, comprising:

an upper mold; and

a lower mold arranged below the upper mold, wherein

the degassing tool forms part of the upper mold, and

the mold body portion forms the upper mold except for the part and the lower mold.

6. The mold according to claim **1**, wherein the degassing tool faces a position in the cavity where a foamable resin material arranged at a predetermined arrangement position in the cavity of the mold reaches last.

7. The mold according to claim **1**, wherein the mold is configured to mold a resin foam body made of polyurethane foam.

8. The mold according to claim **1**, wherein the mold is configured to mold a seat pad.

9. The mold according to claim **1**, wherein the degassing tool is configured to allow gas in the cavity, but not a foamable resin material arranged in the cavity of the mold, to pass therethrough.

10. The mold according to claim **1**, wherein the degassing tool is a 3D printed object.

11. The mold according to claim **1**, wherein the degassing tool is configured in a grid form.

12. The mold according to claim **2**, wherein a difference in linear expansion coefficient between a metal of which the mold body portion is formed and a metal of which the degassing tool is formed is 15×10^{-6}/K or less.

13. The mold according to claim **2**, wherein the degassing tool extends over an entirety in a thickness direction of the mold.

14. The mold according to claim **3**, wherein the degassing tool extends over an entirety in a thickness direction of the mold.

15. The mold according to claim **2**, comprising:

an upper mold; and

a lower mold arranged below the upper mold, wherein

the degassing tool forms part of the upper mold, and

the mold body portion forms the upper mold except for the part and the lower mold.

16. The mold according to claim **3**, comprising:

an upper mold; and

a lower mold arranged below the upper mold, wherein

the degassing tool forms part of the upper mold, and

the mold body portion forms the upper mold except for the part and the lower mold.

17. A method of manufacturing a resin foam body using the mold according to claim **1**, the method comprising:

a foam molding step of foam molding a resin foam body, by arranging a foamable resin material at a predetermined arrangement position in a cavity of the mold and closing the mold; and

a mold release agent application step, performed before the foam molding step, of applying a mold release agent to a molding surface of the mold, wherein

in the foam molding step, gas in the cavity is released to outside of the mold through the degassing tool, and

in the mold release agent application step, the mold release agent is allowed to permeate the degassing tool from outside the mold and reach a surface of the degassing tool that is on a side of the cavity.

18. The method according to claim **17**, wherein the degassing tool faces a position in the cavity where the foamable resin material arranged at the predetermined arrangement position in the foam molding step reaches last.

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