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(54) **PACKAGE, PACKAGE ASSEMBLY, AND PACKAGING METHOD**

(57) A package (1) of the present invention includes: stacks (5) each including a plurality of brittle thin-sheet materials (50); stack holders (6) holding the stacks (5); and a packaging container including at least a body portion (4) having a plurality of recessed portions (41). The stacks (5), together with the stack holders (6), are fitted in the recessed portions (41) in such a manner that a face of each stack (5) that is formed along a stacking direction of the stack (5) faces a bottom face of the recessed portion (41). With this configuration, breakage of the brittle thin-sheet materials (50) can be reduced.

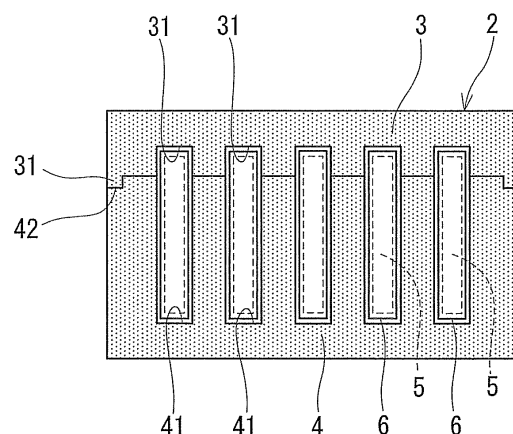


FIG.2B

Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to a package including brittle thin-sheet materials and to a package assembly containing the package. The present invention also relates to a packaging method for forming the package.

BACKGROUND ART

10 **[0002]** Conventionally, when brittle thin-sheet materials such as ceramic sheets are transported or stored, measures to protect the brittle thin-sheet materials are taken. For example, Patent Literature 1 discloses that a plurality of brittle thin-sheet materials 10 are put into a portion bag 11 as shown in FIG. 14B, the packs thus formed are arranged in an upright position in a packaging box 13 as shown in FIG. 14A, and buffer members 12 are disposed on both sides of the arranged packs. The height of the portion bag 11 is smaller than the height of the brittle thin-sheet materials 10, and the
15 upper parts of the brittle thin-sheet materials 10 are exposed from the portion bag 11. It is also disclosed that the packaging boxes 13 containing the packs of the brittle thin-sheet materials 10 are held in tray-like buffering holders (omitted in the figures) in a transport container (omitted in the figures) in such a manner that the stacking direction of the brittle thin-sheet materials 10 coincides with the vertical direction.

20 CITATION LIST

Patent Literature

25 **[0003]** Patent Literature 1: JP 2000-226087 A

SUMMARY OF INVENTION

Technical Problem

30 **[0004]** With the configuration as shown in FIG. 14A, however, there is a possibility that the brittle thin-sheet materials 10 collide with the packaging box 13 directly or via the portion bag 11, for example, due to vibration or dropping during transportation, and thus are broken.

[0005] In view of these circumstances, the present invention aims to provide a package capable of preventing breakage of brittle thin-sheet materials and also to provide a package assembly containing the package and a packaging method
35 for forming the package.

Solution to Problem

40 **[0006]** In order to solve the above problem, the package of the present invention includes: stacks each including a plurality of brittle thin-sheet materials; stack holders holding the stacks; and a packaging container including at least a body portion having a plurality of recessed portions, the package being characterized in that the stacks, together with the stack holders, are fitted in the recessed portions in such a manner that a face of each stack faces a bottom face of the recessed portion, the face of the stack being formed along a stacking direction of the stack.

[0007] The package assembly of the present invention containing the above package is characterized by including
45 the package and a packaging box containing the package.

[0008] The packaging method of the present invention is characterized by including the steps of: holding stacks each including a plurality of brittle thin-sheet materials by stack holders; and fitting the stacks together with the stack holders into a plurality of recessed portions provided in a body portion of a packaging container in such a manner that a face of each stack faces a bottom face of the recessed portion, the face of the stack being formed along a stacking direction of
50 the stack.

Advantageous Effects of Invention

55 **[0009]** According to the present invention, in the body portion of the packaging container, the stack including the brittle thin-sheet materials is fitted in the recessed portion of the body portion together with the stack holder in such a manner that a face of the stack that is formed along the stacking direction of the stack faces a bottom face of the recessed portion. Thus, the possibility of the brittle thin-sheet materials being broken by vibration or dropping during transportation can be reduced.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

FIG. 1 is a perspective view of a package according to an embodiment of the present invention and a packaging box for containing the package.

FIG. 2A is a cross-sectional view of the package shown in FIG. 1.

FIG. 2B is a cross-sectional view of the package shown in FIG. 1.

FIG. 3A is a perspective view of a lid portion of a packaging container.

FIG. 3B is a perspective view of a body portion of the packaging container.

FIG. 4 is a perspective view of a stack and a stack holder.

FIG. 5 is a perspective view of a modified example of the stack.

FIG. 6 is a perspective view of a modified example of a set of the stack and the stack holder.

FIG. 7 is a perspective view of another modified example of a set of the stack and the stack holder.

FIG. 8 is a perspective view of still another modified example of a set of the stack and the stack holder.

FIG. 9 is a cross-sectional view showing a modified example of the package.

FIG. 10 is a cross-sectional view showing another modified example of the package.

FIG. 11 is a cross-sectional view showing still another modified example of the package.

FIG. 12 is a cross-sectional view showing still another modified example of the package.

FIG. 13 is a perspective view of a packaging container according to another embodiment.

FIG. 14A is a cross-sectional view showing an inner configuration of a conventional packaging box.

FIG. 14B is a perspective view of a portion bag in which brittle thin-sheet materials are contained.

DESCRIPTION OF EMBODIMENTS

[0011] Hereinafter, embodiments of the present invention will be described with reference to the drawings. The following description relates to illustrative examples of the present invention, and the present invention is not limited by these examples.

[0012] A package 1 according to an embodiment of the present invention is shown in FIG. 1. In the present embodiment, the package 1 is in the shape of a rectangular parallelepiped. The package 1 is to be contained in a packaging box 7. A package assembly according to an embodiment of the present invention includes the package 1 and the packaging box 7 containing the package 1.

[0013] The packaging box 7 is, for example, a corrugated fiberboard box. For example, it is preferable that reinforcing plates be disposed on the inner faces (the four side faces, bottom face, and ceiling face) of the packaging box 7 and thus be disposed between the packaging box 7 and the package 1. Wooden boards (wood plates), compressed boards made of paper, foamed plastic boards, or the like, can be used as the reinforcing plates. With the use of the packaging box 7 having reinforcing plates disposed between the packaging box 7 and the package 1, the package 1 can be protected from external forces. Alternatively, a reinforcing plate may be joined between the package 1 and a part or the whole of at least one inner face of the packaging box 7. In addition, a buffer member such as an elastic body or a bubble buffer material may be provided between the package 1 and a part or the whole of at least one inner face of the packaging box 7. In this case, the reinforcing plate may be omitted. Also with such a configuration, the package 1 can be protected from external forces.

[0014] When the packaging box 7 is a corrugated fiberboard box, the packaging box 7 is constituted by outer linerboards, inner linerboards, and corrugating media having a wavy shape. The corrugating medium is disposed between and joined to the outer linerboard and the inner linerboard. The height of the flute (the distance between the outer linerboard and the inner linerboard) of the packaging box 7 is, for example, 0.5 mm to 5mm, and preferably 1.5 to 5 mm. The mass per 1 m² of each of the outer linerboard and the inner linerboard is, for example, 100 to 300 g, and preferably 150 to 280 g. The mass per 1 m² of the corrugating medium is, for example, 100 to 200 g, and preferably 120 to 180 g. From the standpoint of enhancing the buffering properties, compressive strength, and breaking strength, a corrugated fiberboard box constituted by W-flute corrugated fiberboards each formed by stacking two types of corrugated fiberboards having flutes of different heights may be used. In this case, it is preferable to use a W-flute corrugated fiberboard formed by combination of a corrugated fiberboard having a 3-mm high flute and a corrugated fiberboard having a 5-mm high flute.

[0015] As shown in FIG. 2A and FIG. 2B, the package 1 includes a plurality of (in the figures, ten) stacks 5 placed in an upright position and a packaging container 2 enclosing the stacks 5. In the present embodiment, the stacks 5 are arranged in two rows each consisting of five of the stacks 5. However, it is not necessary that the stacks 5 be arranged in two rows. For example, the stacks 5 may be arranged in a single row or may be arranged in three or more rows. Alternatively, the packaging container 2 may be configured to enclose only a single stack 5.

[0016] As shown in FIG. 4, each stack 5 includes a plurality of brittle thin-sheet materials 50. The stack 5 is held by a

stack holder 6 that is, for example, in the form of a bag. The stack holder 6 may be any member that can prevent the plurality of brittle thin-sheet materials 50 from separating from each other and can maintain the stacking state of the stack 5. For example, the stack holder 6 may have the form of a rectangular envelope having two faces joined together at their respective three sides or the form of a rectangular file having two faces joined together at their respective two adjacent or opposite sides. The thickness of each face is, for example, 0.03 to 1.5 mm, preferably 0.04 mm to 1.0 mm, and more preferably 0.04 to 0.5 mm. For example, in the case where the stack holder 6 is in the form of an envelope, the stack 5 is inserted into the stack holder 6, after which the opening side of the stack holder 6 is folded and fixed by a tape and the four corners of the stack holder 6 are folded into a triangular shape and fixed by tapes in such a manner that the entire stack holder 6 is in close contact with the stack 5. Thus, the stack 5 is held, and the stacking state of the brittle thin-sheet materials 50 is maintained. Alternatively, the stack holder 6 can be in the form of a packaging film for holding the stack 5. In this case, reduced-pressure packaging or vacuum packaging can be achieved by depressurizing the inside of the packaging film serving as the stack holder 6. Furthermore, in this case, overwrap packaging, shrink packaging, packaging by an OPP (biaxially-oriented polypropylene) bag, or the like, may be employed.

[0017] The stack 5 may be configured by stacking the brittle thin-sheet materials 50 alone, but is not limited to such a configuration. For example, as shown in FIG. 5, spacers 51 such as pieces of paper, sheet-like sponges, or polyethylene sheets may be disposed between the brittle thin-sheet materials 50. In this case, the respective one sides of the plurality of spacers 51 may be joined together to form a book-shaped holder. In addition, a buffer member may be attached to at least a part of an outer surface of the stack 5.

[0018] The stack holder 6 is not limited to that which is in the form of a bag. For example, as shown in FIG. 6, the stack holder may be a single sheet 63 for wrapping the stack 5. Alternatively, as shown in FIG. 7, the stack holder may be bands 61 each surrounding two pairs of opposite side faces of the stack 5. Furthermore, as shown in FIG. 8, the stack holder may be constituted by: two sheets 65A and 65C covering two outer faces of the stack 5 that are opposite to each other in a stacking direction of the stack 5; and a connection portion 65B connecting the sheets 65A and 65C. In this case, one side of each spacer 51 disposed between the brittle thin-sheet materials 50 may be joined to the connection portion 65B. From the standpoint of enhancing protection of the stack 5, however, it is preferable that the stack holder 6 be configured to cover the whole of the stack 5. In particular, it is preferable that the stack holder 6 be in the form of a bag that can cover the whole of the stack 5.

[0019] The material of the stack holder 6 that is in the form of a bag is not particularly limited. From the standpoint of preventing adhesion of dust, it is preferable to use a bag having antistatic properties. However, the stack holder 6 may be made of polyethylene or polypropylene. As used herein, the term "antistatic properties" means the property of having a surface resistivity of 10^{10} Ω /sq. or less or preferably 10^9 Ω /sq. or less under conditions of 20°C and 15%RH.

[0020] The number of the brittle thin-sheet materials 50 constituting one stack 5 is, for example, about 5 to 500, and preferably about 10 to 200. In the stack holder 6, the brittle thin-sheet materials 50 may be stacked directly on each other, or each of the brittle thin-sheet materials 50 or sets of several brittle thin-sheet materials may be contained individually in a separate bag. In the case where the brittle thin-sheet material 50 is a structure in which one face and its reverse face are formed with different materials as described later, the brittle thin-sheet materials 50 may be stacked in alternately-inverted orientations so that the faces made of the same material face each other, or the brittle thin-sheet materials 50 may be stacked in the same orientation so that the faces made of different materials face each other.

[0021] The brittle thin-sheet material 50 is a thin, brittle sheet material that could be fractured, chipped, or deformed during packaging, during transportation, or the like. A typical example thereof is a ceramic compact in the form of a thin-sheet. Examples of the ceramic compact in the form of a thin sheet include: a dense ceramic body for use in an electric circuit board or in an electrolyte sheet or separator of a solid oxide fuel cell (SOFC); a porous ceramic body for use in an electrode of a SOFC; a structure formed by combination of a plurality of dense ceramic bodies; a structure formed by combination of a dense ceramic body and a porous ceramic body; a structure (e.g., a single cell of a fuel cell) in which porous ceramic bodies are disposed on both sides of a dense ceramic body; and a structure formed by combination of a plurality of porous ceramic bodies.

[0022] The following can be used as the material of the dense ceramic body for use in an electric circuit board: alumina; zirconia; aluminum nitride; mullite; cordierite; a mixture of alumina and borosilicate glass; and a mixture of cordierite and borosilicate glass.

[0023] The following can be used as the material of the dense ceramic body for use in an electrolyte sheet for an electrolyte-supported cell of a SOFC: stabilized zirconia having added thereto an oxide of a rare-earth element, an alkaline-earth element, or the like; a lanthanum gallate-based perovskite-type composite oxide such as LaGaO_3 or LaSrGaMgO_3 ; and a ceria-based composite oxide such as gadolinium-doped ceria or samaria-doped ceria.

[0024] Specific examples of the stabilized zirconia include zirconia stabilized with 3 mol% to 15 mol% of yttria, zirconia stabilized with 3 mol% to 15 mol% of scandia, zirconia stabilized with 3 mol% to 15 mol% of ytterbia, zirconia stabilized with 8 mol% to 12 mol% of scandia and 0.5 mol% to 3 mol% of ceria, and zirconia stabilized with 3 mol% to 15 mol% of yttria and scandia (0 mol% < yttria, scandia $\leq$ 15 mol%).

[0025] The following can be used as the material of the dense ceramic body for use in a separator of a SOFC: a

lanthanum chromite-based perovskite-type composite oxide such as LaCrO_3 , LaCaCrO_3 , or LaSrCrO_3 .

[0026] The following can be used as the material of the porous ceramic body for use in a fuel electrode substrate or the like for an anode-supported cell of a SOFC: a mixture of nickel oxide and the above-mentioned stabilized zirconia; a mixture of nickel oxide and the above-mentioned ceria-based composite oxide; and a mixture of nickel oxide, the above-mentioned stabilized zirconia, and the above-mentioned ceria-based composite oxide.

[0027] The following can be used as the material of the porous ceramic body for use in an air electrode substrate or the like for a cathode-supported cell of a SOFC: a composite oxide of the perovskite type or the like, such as LaCoO_3 , LaSrCoO_3 , LaMnO_3 , LaSrMnO_3 , or LaNiFeO_3 ; a mixture of the perovskite-type composite oxide and the above-mentioned stabilized zirconia; a mixture of the perovskite-type composite oxide and the above-mentioned ceria-based composite oxide; and a mixture of the perovskite-type composite oxide, the above-mentioned stabilized zirconia, and the above-mentioned ceria-based composite oxide.

[0028] The above-mentioned materials may be used alone, or two or more thereof may be used in appropriate combination as necessary.

[0029] The shape of the brittle thin-sheet material 50 is not particularly limited, and may be any of a circular shape, an ellipsoidal shape, a rectangular shape, and a rounded-corner rectangular shape. Alternatively, the brittle thin-sheet material 50 may be in a shape having a hole for gas passage and, for example, may be in a doughnut shape. Also, grooves for scribing, or depressions presenting a dimple pattern, may be formed in the surface of the brittle thin-sheet material 50.

[0030] The outline area of the brittle thin-sheet material 50 (the area defined by the contour regardless of the presence or absence of a hole) is, for example, 25 cm^2 or more and 1000 cm^2 or less. The outline area of the brittle thin-sheet material 50 is preferably 50 cm^2 or more and 900 cm^2 or less, and more preferably 80 cm^2 or more and 600 cm^2 or less.

[0031] The thickness of the brittle thin-sheet material 50 is, for example, 0.03 mm or more and 0.5 mm or less. The thickness of the brittle thin-sheet material 50 is preferably 0.1 mm or more and 0.3 mm or less, and more preferably 0.12 mm or more and 0.25 mm or less.

[0032] When the brittle thin-sheet material 50 is an alumina-based material, the outline area of the brittle thin-sheet material 50 is preferably 25 cm^2 or more and 250 cm^2 or less, more preferably 30 cm^2 or more and 150 cm^2 or less, and even more preferably 50 cm^2 or more and 100 cm^2 or less. In addition, the thickness of the brittle thin-sheet material 50 is preferably 0.1 mm or more and 0.5 mm or less, more preferably 0.12 mm or more and 0.45 mm or less, and even more preferably 0.15 mm or more and 0.4 mm or less.

[0033] When the brittle thin-sheet material 50 is a zirconia-based material, the outline area of the brittle thin-sheet material 50 is preferably 50 cm^2 or more and 1000 cm^2 or less, more preferably 80 cm^2 or more and 900 cm^2 or less, and even more preferably 100 cm^2 or more and 600 cm^2 or less. In addition, the thickness of the brittle thin-sheet material 50 is preferably 0.03 mm or more and 0.45 mm or less, more preferably 0.05 mm or more and 0.4 mm or less, and even more preferably 0.1 mm or more and 0.35 mm or less.

[0034] The material of the packaging container 2 is not particularly limited. It is recommended that at least a part of the packaging container 2 be a foam. For example, polystyrene, which is inexpensive, can be used as the constituent material of the foam. From the standpoint of the strength of the packaging container 2, however, reinforced polypropylene may be used. Alternatively, polyurethane may be used as the constituent material of the foam. For example, it is recommended that in the packaging container 2, recessed portions 41 of a body portion 4 and a lid portion 3 that are to come into contact with the stacks 5 or the stack holders 6 be formed of a foam. Alternatively, the packaging container 2 may be constituted by corrugated fiberboards, compression boards made of paper, or the like. Furthermore, projections and depressions may be provided in the outer surface of the packaging container 2.

[0035] When at least a part of the packaging container 2 is a foam, the foaming magnification of the foam is preferably 10-fold or more and 90-fold or less, more preferably 20-fold or more and 80-fold or less, and even more preferably 30-fold or more and 70-fold or less, from the standpoint of the property of cushioning for the brittle thin-sheet materials. The entire foam need not have the same uniform foaming magnification. For example, in the recessed portions 41 of the body portion 4 and the lid portion 3 which are in contact with the stacks 5 or the stack holders 6, the foaming magnification of the foam may be 40-fold to 90-fold and preferably 50 to 80-fold, while in other portions, the foaming magnification of the foam may be 10-fold to 60-fold and preferably 20 to 50-fold. The term "foaming magnification" as used herein means the volume per unit mass which is an inverse of the bulk density, and the unit of foaming magnification is "volume/mass". In the present description, "fold" is used instead of the unit "volume/mass".

[0036] The body portion 4 has a plurality of (in FIG. 3B, ten) recessed portions 41. Each stack 5, together with the stack holder 6, is fitted into the recessed portion 41. Each stack 5, together with the stack holder 6, is fitted in the recessed portion 41, for example, in such a manner that a face of the stack 5 that is formed along the stacking direction faces the bottom face of the recessed portion 41. In the present embodiment, the depth of the recessed portion 41 is smaller than the length of one side of the brittle thin-sheet material 50, and the upper part of the stack 5 placed in an upright position projects from the body portion 4.

[0037] The recessed portion 41 has approximately the same shape as the lower part of the stack 5 placed in an upright

position. That is, one of the horizontal dimensions of the recessed portion 41 is slightly larger than the length of another side of the brittle thin-sheet material, and the other horizontal dimension of the recessed portion 41 is slightly larger than the thickness of the stack 5. Therefore, when the stack 5, together with the packing material 6, is fitted in the recessed portion 41, the stack 5 is held with its position maintained. It is preferable that a pair of faces of the stack 5 that are opposed to each other across the center of the stack 5 be fixed by the recessed portion 41. In this case, it is preferable that a pair of faces of the stack 5 that are opposed to each other across the center of the stack 5 and that are formed along the stacking direction of the stack 5 be fixed by the recessed portion 41. With these features, the possibility of the brittle thin-sheet materials being broken by vibration during transportation of the package 1 can be reduced. The center of the stack 5 is a midpoint of a line segment connecting the center of the principal face of the brittle thin-sheet material 50 disposed on one end of the stack 5 and the center of the principal face of the brittle thin-sheet material 50 disposed on the other end of the stack 5.

[0038] A distance D1 (see FIG. 3B) between each two recessed portions 41 adjacent in the stacking direction of the stack 5 may be determined as appropriate depending on the size of the stack 5, and may be 20 mm or less. From the standpoint of reducing the size of the packaging container 2, the distance D1 is preferably 10 mm or less, more preferably 8 mm or less, and even more preferably 6 mm or less. From the standpoint of protecting the stacks 5, the distance D between the recessed portions 41 is, for example, 1 mm or more, and preferably 2 mm or more.

[0039] The package 1 further includes the lid portion 3 covering the stacks 5 over the recessed portions 41. The lid portion 3 covers the stacks 5 over the body portion 4. In the present embodiment, the lid portion 3 is also provided with recessed portions 31 in each of which the stack 5, together with the stack holder 6, is fitted. It is preferable that a pair of faces of the stack 5 that are opposed to each other across the center of the stack 5 and that are formed along the stacking direction of the stack 5 be fixed by the recessed portion 41 and the lid portion 3. In other words, it is preferable that edge faces of the stack 5 that are opposed to each other across the center of the stack 5 be fixed by the recessed portion 41 and the lid portion 3. With this feature, it is possible to prevent the stack 5 from moving and colliding with the packaging container 2 during transportation or the like. Accordingly, the possibility of the brittle thin-sheet material 50 being broken can be reduced. As shown in FIG. 9, the lid portion 3 may be provided with a hollow portion 35 that is relatively large and surrounds the upper parts of all the stacks 5. In this case, the stacks 5 are pressed against the recessed portions 41 by the bottom face of the hollow portion 35. Alternatively, in the case where the depth of the recessed portion 41 of the body portion 4 is slightly larger than one side of the brittle thin-sheet material 50, the lid portion 3 may be in the form of a flat plate. In this case, the space between the stacks 5 and the lid portion 3 is filled with a spacer or the like including a buffer member, so that the stacks 5 are pressed against the recessed portions 41 by the lid portion 3. The stack holder 6 may serve as the spacer. Alternatively, the top face of the packaging box 7 may be configured to serve as the lid portion 3. Still alternatively, the package 1 may include a plurality of lid portions each covering one or more of the recessed portions 41.

[0040] As shown in FIG. 10, the recessed portions 41 may be formed in an inclined manner. With this configuration, the height of the packaging container 2 can be reduced.

[0041] As shown in FIG. 11, the depth of the recessed portion 41 provided in the body portion 4 may be larger than one side of the brittle thin-sheet material 50. In this case, the lid portion 3 may further have projections 37 that fit in the recessed portions 41. With this feature, the stacks 50 can be pressed against the recessed portions 41 by the projections 37 of the lid portion 3. In addition, the stacks 50 can be held further away from the outer face of the packaging container 2 and, therefore, impact from outside can be reduced.

[0042] The magnitude relation between the height of the body portion 4 and the height of the lid portion 3 is not particularly limited. The height of the body portion 4 may be larger than the height of the lid portion 3 or the height of the lid portion 3 may be larger than the height of the body portion 4. The height of the body portion 4 and the height of the lid portion 3 may be equal. However, in order to protect the stacks 5 by deeper recessed portions, it is preferable that either the height of the body portion 4 or the height of the lid portion 3 be larger than the other.

[0043] As shown in FIG. 3A, a surrounding wall 32 in the form of a rectangular frame is formed along the periphery of the lower face of the lid portion 3. In addition, a stepped portion 42 into which the surrounding wall 32 fits is formed, as shown in FIG. 3B, along the periphery of the upper face of the body portion 4. A recessed portion may be formed in the surrounding wall 32, and a projection that engages with the recessed portion may be formed in the stepped portion 42. Alternatively, a recessed portion may be formed in the stepped portion 42, and a projection that engages with the recessed portion may be formed in the surrounding wall 32. With the projection engaging with the recessed portion, the lid portion 3 is less likely to be detached from the body portion 4.

[0044] As shown in FIG. 12, projections 31A and 41A may be respectively formed on the side faces of the recessed portion 31 of the lid portion 3 and the side faces of the recessed portion 41 of the body portion 4. A pair of the edge faces of the stack 5 that are opposed to each other across the center of the stack 5 may be fixed by the projections 31A and 41A. The shape of the projection is not particularly limited, and may be a dimple-like shape that allows point contact with the stack 5 or the stack holder 6. Alternatively, the shape of the projection may be a shape that allows line contact with the stack 5 or the stack holder 6. Still alternatively, the shape of the projection may be a shape in which faces to

be in contact with the stack 5 or the stack holder 6 are arranged at intervals.

[0045] Next, a method for forming the package 1 will be described.

[0046] First, as shown in FIG. 4, the stacks 5 each including a plurality of brittle thin-sheet materials 50 are held by the stack holders 6. For example, the stacks 5 are put into the stack holders 6 that are in the form of a bag. At this time, it is preferable to seal the stacks 5 with the stack holders 6 as described above. Subsequently, the stacks 5, together with the stack holders 6, are fitted into the plurality of recessed portions 41 of the body portion 4 of the packaging container 2 in such a manner that a face of each stack 5 that is formed along the stacking direction faces the bottom face of the recessed portion 41. The lid portion 3 may be mounted so as to cover the stacks 5 over the recessed portions 41. Thus, the stacks 5 are covered by the lid portion 3. In the present embodiment, this operation may be performed along with insertion of the stacks 5 into the recessed portions 31 of the lid portion 3. In this manner, the package 1 is formed.

[0047] The package 1 formed may be placed directly on a carrying pallet, but is preferably contained in the packaging box 7 shown in FIG. 1 that has reinforcing plates joined to its inner faces. This is because deformation of the packaging box 7 and the package 1 can be prevented even when a fork of a forklift accidentally contacts the packaging box 7.

[0048] The packaging container 2 according to another embodiment of the present invention is shown in FIG. 13. The lid portion 3 is in the form of a box having one open face. The body portion 4 includes a base portion 45 and a plurality of partition portions 47 arranged in an array on the base portion 45. Recessed portions 49 are each formed by the base portion 45 and the respective side faces of two adjacent partition portions 47. The stacks 5, together with the stack holders 6, are fitted into the recessed portions 49. In the body portion 4, a stepped portion 45A is formed along the periphery of the base portion 45 so as to surround the base portion 45. The lid portion 3 covers the stacks 5 over the body portion 4 by being mounted on the body portion 4 in such a manner that an edge portion 39 of the opening of the lid portion 3 and the stepped portion 45A are fitted together. In this case, the bottom face of the lid portion 3 presses the stacks 50 against the base portion 45 constituting a part of each recessed portion 49. Thus, the stacks 5 can be held in the packaging container 2.

[0049] In FIG. 13, the plurality of partition portions 47 are arranged in two rows so as to form two rows of the recessed portions 49. The partition portions 47 may be arranged in a single row or may be arranged in three or more rows. It is sufficient that the plurality of partition portions 47 be provided so as to form one or more recessed portions 49. The range of a distance D2 between the recessed portions 49 (the thickness of the partition portion 47) is the same as the range of the distance D1 between the recessed portions 41.

[0050] In the package 1 of the present embodiment described above, the brittle thin film sheets 50 can be doubly protected by the packaging container 2 and the stack holders 6 and, therefore, the breakage of the brittle thin-sheet materials 50 can be prevented.

[0051] In particular, when the brittle thin-sheet material 50 is a zirconia-based material, it is possible to obtain a marked effect of preventing "chipping", "cracking", and "denting" of edge faces or principal faces of the brittle thin-sheet materials 50 where breakage would be particularly likely to occur.

EXAMPLES

[0052] Next, the present invention will be described with reference to examples. However, the examples given below are illustrative examples of the present invention, and the present invention is not limited to the examples given below.

(Free-fall drop test)

[0053] First, methods of evaluation of Examples and Comparative Example will be described. In accordance with JIS (Japanese Industrial Standards) Z 0202-1994, each of the packages and the package assemblies according to Examples and Comparative Example was allowed to free-fall from a height of 60 cm to a floor in such a manner that the drop attitude met the requirements for face drops. The floor was in a form having a concrete surface subjected to urethane coating. After the test, all of the sheets of 8YSZ (zirconia stabilized with 8 mol% of yttria) contained in the package or the package assembly was visually inspected for the breakage (fracture) of the sheets. In addition, detection of surface "chipping" and "cracking" was carried out by a transmissive photoelectric sensor for all the 8YSZ sheets. The number of 8YSZ sheets for which breakage or defect was observed was divided by the total number of the tested 8YSZ sheets to calculate the breakage rate and the defect generation rate.

(Incline impact test)

[0054] In accordance with JIS Z 0205-1998, incline impact tests were performed in which each of the packages and the package assemblies according to Examples and Comparative Example was placed on a sliding carriage on rails, and was allowed to collide with an impact plate at an inclination angle of 10°. After the test, all of the 8YSZ sheets contained in the package or the package assembly were visually inspected for breakage (fracture) of the sheets. In

addition, detection of surface "chipping" and "cracking" was carried out by a transmissive photoelectric sensor for all the 8YSZ sheets. The number of 8YSZ sheets for which breakage or defect was observed was divided by the total number of the tested 8YSZ sheets to calculate the breakage rate and the defect generation rate.

(Example 1)

[0055] A stack formed by stacking 125 pieces of 120-mm square, 120- μ m thick 8YSZ sheets (manufactured by NIPPON SHOKUBAI CO., LTD.) was put into a commercially-available antistatic polyethylene bag (thickness: 0.05 mm, surface resistivity: $10^8 \Omega/\text{sq.}$) serving as a stack holder. The opening of the bag was closed, and the edge on the opening side was folded and adhered to the outer surface of the bag. In addition, the four corners of the bag were folded in a triangular shape and adhered to the outer surface of the bag. In this manner, the stack was held by the stack holder. Next, ten such stacks each held by the stack holder were placed in a packaging container as shown in FIG. 1 that was made of a polystyrene foam having a foaming magnification of about 50-fold. Specifically, each stack, together with the stack holder, was fitted into a recessed portion of the body portion of the packaging container in such a manner that the stacking direction of the stack coincided with the horizontal direction (a face of the stack that was formed along the stacking direction faced the bottom face of the recessed portion of the body portion of the packaging container). Then, a lid portion was mounted over the stacks. A pair of end portions (upper end portion and lower end portion) of each stack were fixed by the recessed portion and the lid portion. In this manner, a package according to Example 1 was fabricated.

[0056] Next, the above package was put in a packaging box as shown in FIG. 1, and foamed styrol plates having a foaming magnification of about 30-fold were inserted over the entire space between the package and the packaging box. The packaging box was a corrugated fiberboard box constituted by W-flute corrugated fiberboards each composed of two corrugated fiberboards one of which had an about 5-mm high flute and the other of which had an about 3-mm high flute. The weight of the linerboards of the corrugated fiberboards per 1 m^2 was about 180 g. In the manner thus described, a package assembly according to Example 1 was fabricated. Free-fall drop tests and incline impact tests were carried out as described above for the package and the package assembly according to Example 1. The results of the free-fall drop tests are shown in Table 1, and the results of the incline impact tests are shown in Table 2.

(Example 2)

[0057] Ten stacks fabricated in the same manner as in Example 1 and each held by the stack holder were inserted into recessed portions of the body portion of a polystyrene foam packaging container as shown in FIG. 1, and a lid portion was mounted over the stacks. A pair of end portions of each stack were fixed by the recessed portion and the lid portion. As a main material of the packaging container, a foam having a foaming magnification of about 40-fold was used. The packaging container had a structure in which sheets of a foam having a foaming magnification of 60-fold were provided on faces to be in contact with the stack holders by being joined to the main material by an adhesive agent. In the manner thus described, a package according to Example 2 was fabricated.

[0058] The above package was put in a packaging box as shown in FIG. 1, and veneer boards serving as reinforcing plates were inserted over the entire space between the package and the packaging box. The packaging box was a corrugated fiberboard box in which the height of the flute was about 3 mm and the weight of the linerboard per 1 m^2 was about 220 g. In the manner thus described, a package assembly according to Example 2 was fabricated. Next, as in Example 1, free-fall drop tests and incline impact tests were performed, and all of the 8YSZ sheets contained in the package or the package assembly were inspected. The results of the free-fall drop tests are shown in Table 1, and the results of the incline impact tests are shown in Table 2.

(Comparative Example 1)

[0059] Sets of the above 8YSZ sheets each consisting of ten pieces of the sheets were separately held by a book-shaped holder as shown FIG. 8 that was made of paper and had a 120-mm square flat shape. Thus, a stack of 250 pieces of the 8YSZ sheets was fabricated. End portion buffer members were disposed on the upper face and the lower face of the stack, and a tape made of polypropylene (trade name: P.P. band, manufactured by SEKISUI CHEMICAL CO., LTD. and having a width of 15 mm) was wound around the stack in a cross shape to firmly bind the stack. Thus, a packed body was obtained. At this time, the surface pressure applied to the 8YSZ sheets was 200 gf/cm^2 . The end portion buffer members were polyethylene foams (trade name SUNPELCA L1400 manufactured by Hayashi Felt Co., Ltd.) having a size of 151 mm square, a thickness of 10 mm, and a density of 0.086 g/cm^3 . The end portion buffer members had, at their centers, a recessed portion (the shape of the recessed portion: 122-mm square, the depth of the recessed portion: 5 mm) into which each of the end portions of the stack was fitted. Next, four such packed bodies were each put in a commercially-available antistatic bag. Furthermore, each packed body contained in the bag was put in a tray-like buffering holder in such a manner that the stacking direction of the stack coincided with the vertical direction

(in such a manner that a face of the stack formed along the stacking direction faced a side face of the recessed portion). Finally, the buffering holders holding the packed bodies were placed in a transport container that was a carrying case made of duralumin. The space between the transport container and the packed bodies contained in the antistatic bags was filled with cushioning materials made of polyethylene (trade name: ASPAC SARASARA, manufactured by Asahi Kasei Corporation). In this manner, a package assembly according to Comparative Example 2 was fabricated. Next, as in Example 1, a free-fall drop test and an incline impact test were performed for the package assembly, and all of the 1000 pieces of the 8YSZ sheets contained in the package assembly were inspected. The result of the free-fall drop test is shown in Table 1, and the result of the incline impact test is shown in Table 2.

[Table 1]

	Packaging form	Breakage rate (%)	Defect generation rate (%)	
			Chipping	Cracking
Example 1	Package	0.1	0.5	0
	Package assembly	0	0.5	0.1
Example 2	Package	0	0.2	0
	Package assembly	0	0.4	0
Comparative Example 1	Carrying case	3.4	1.1	4.7

[Table 2]

	Packaging form	Breakage rate (%)	Defect generation rate (%)	
			Chipping	Cracking
Example 1	Package	0	0.4	0
	Package assembly	0	0.5	0.1
Example 2	Package	0	0.1	0.1
	Package assembly	0	0.2	0
Comparative Example 1	Carrying case	1.8	2.3	1.1

[0060] From the results of the tests, the effectiveness of using the packages and the package assemblies according to Example 1 and Example 2 was confirmed. The breakage rates in Example 1 and Example 2 were smaller than the breakage rate in Comparative Example 1. In addition, the defect generation rates for chipping and cracking in Example 1 and Example 2 were smaller than the defect generation rates for chipping and cracking in Comparative Example 1.

Claims

1. A package comprising:

stacks each comprising a plurality of brittle thin-sheet materials;
 stack holders holding the stacks; and
 a packaging container comprising at least a body portion having a plurality of recessed portions,
 wherein the stacks, together with the stack holders, are fitted in the recessed portions in such a manner that a face of each stack faces a bottom face of the recessed portion, the face of the stack being formed along a stacking direction of the stack.

2. The package according to claim 1, wherein a pair of faces of the stack that are opposed to each other across a center of the stack are fixed by the recessed portion.

3. The package according to claim 2, wherein a pair of faces of the stack that are opposed to each other across the center of the stack and that are formed along the stacking direction of the stack are fixed by the recessed portion.

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4. The package according to claim 1, further comprising a lid portion,
wherein the lid portion covers the stacks over the recessed portions.
5. The package according to claim 4, wherein a pair of faces of the stack that are opposed to each other across a
center of the stack and that are formed along the stacking direction of the stack are fixed by the recessed portion
and the lid portion.
6. The package according to any one of claims 1 to 5, wherein at least a part of the packaging container is a foam.
7. The package according to claim 6, wherein the foam contains polystyrene, reinforced polypropylene, or polyurethane.
8. A package assembly comprising:

the package according to any one of claims 1 to 7; and
a packaging box containing the package.
9. The package assembly according to claim 8, wherein a reinforcing plate is disposed between the packaging box
and the package.
10. A packaging method comprising the steps of:

holding stacks each including a plurality of brittle thin-sheet materials by stack holders; and
fitting the stacks together with the stack holders into a plurality of recessed portions provided in a body portion
of a packaging container in such a manner that a face of each stack faces a bottom face of the recessed portion,
the face of the stack being formed along a stacking direction of the stack.

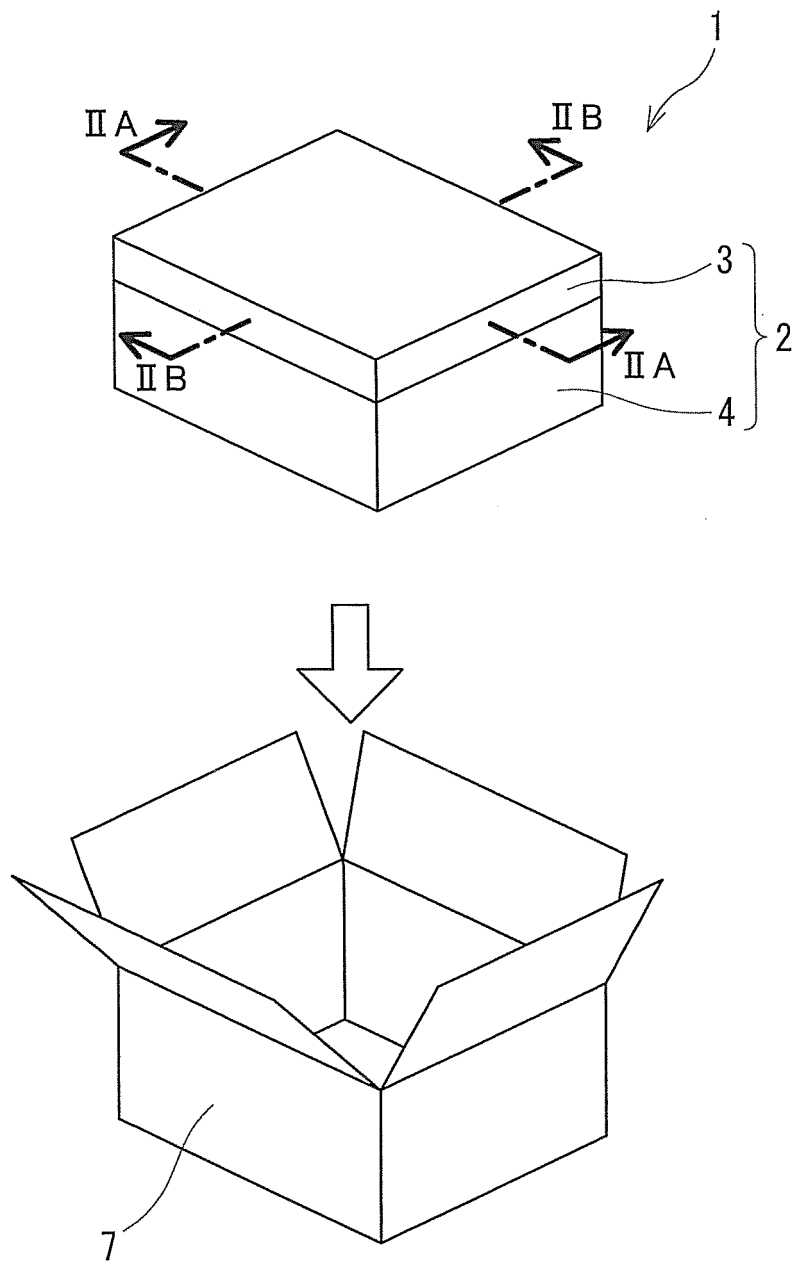


FIG.1

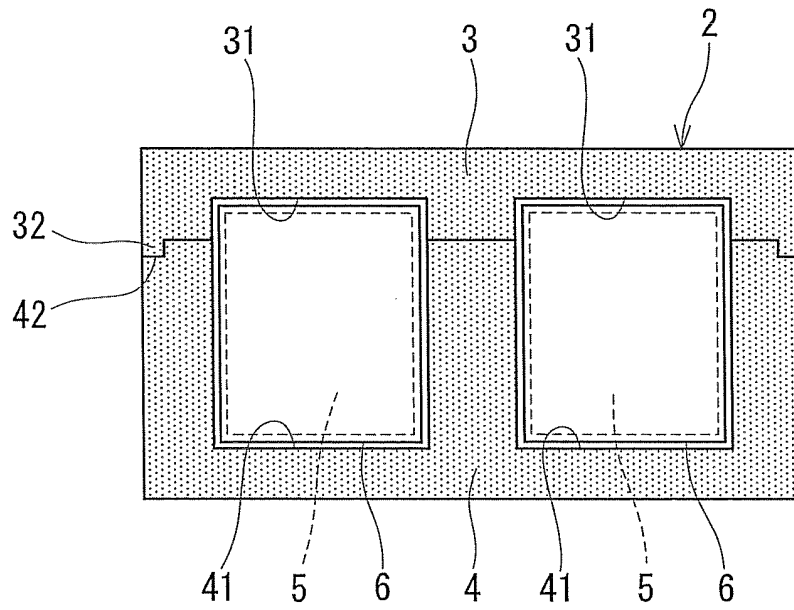


FIG. 2A

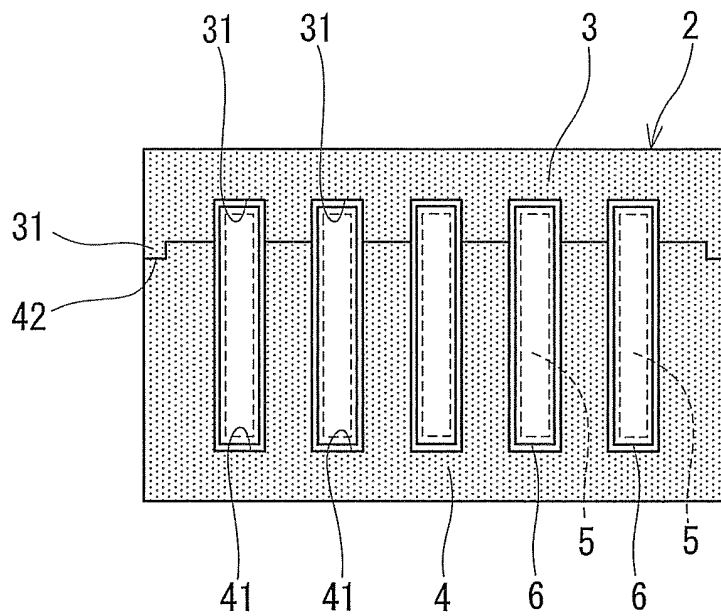


FIG. 2B

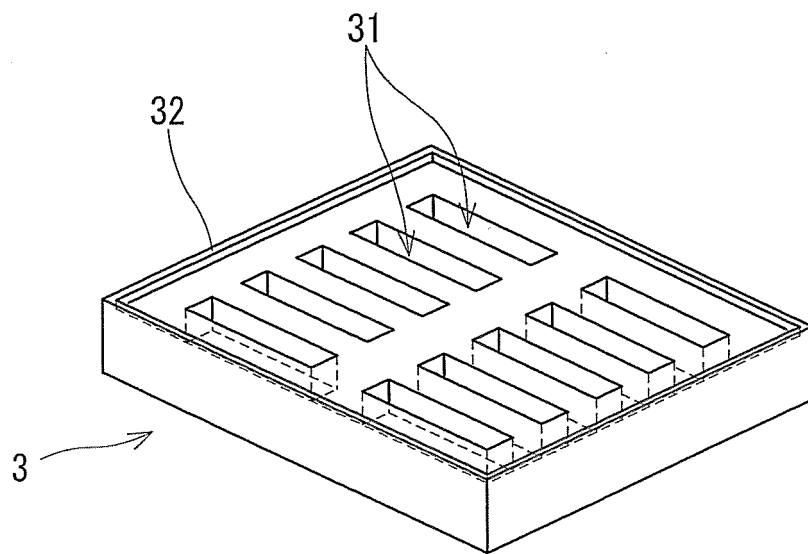


FIG. 3A

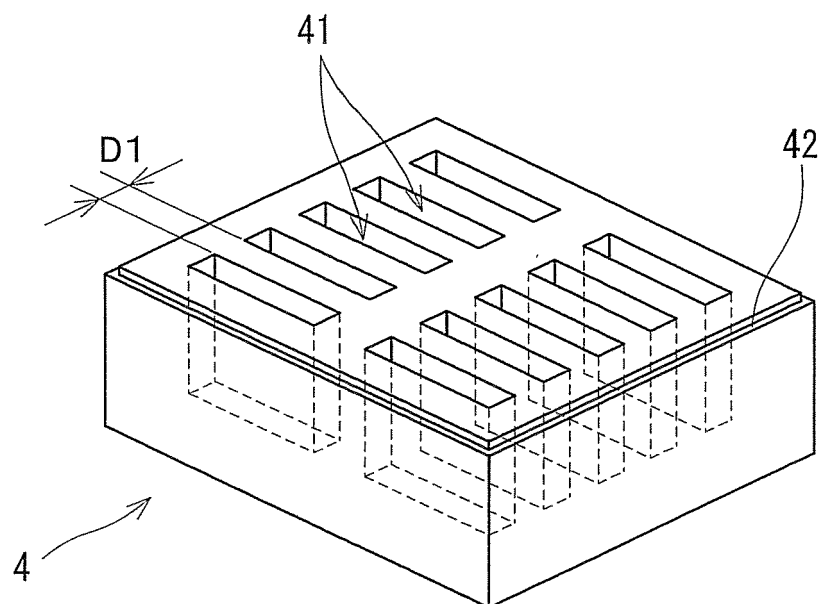


FIG. 3B

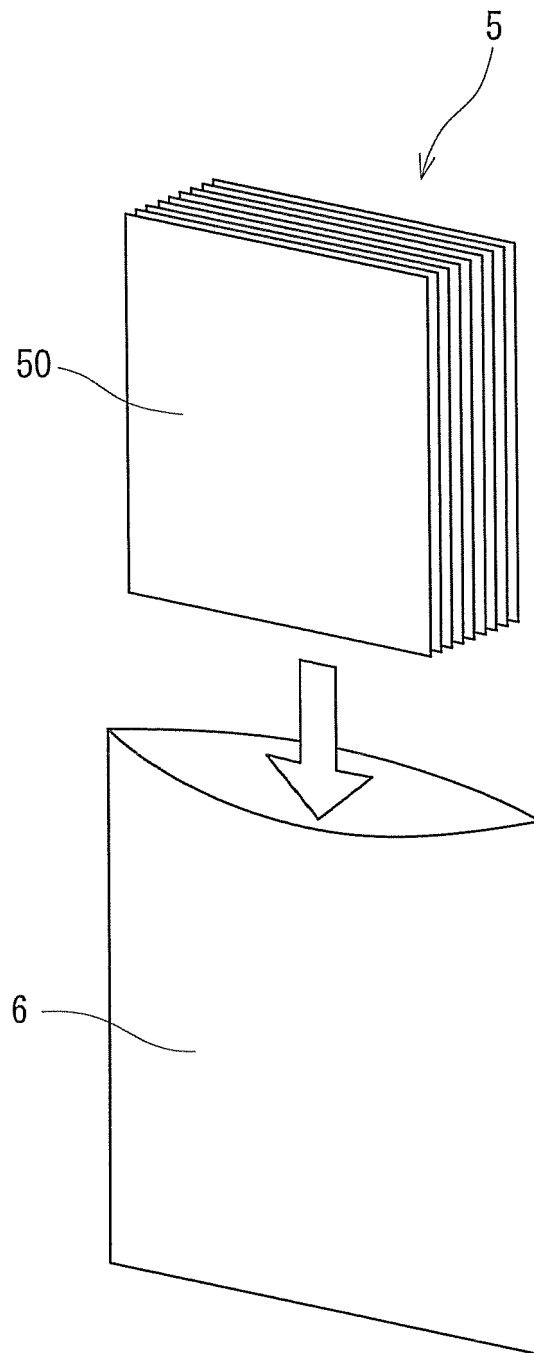


FIG.4

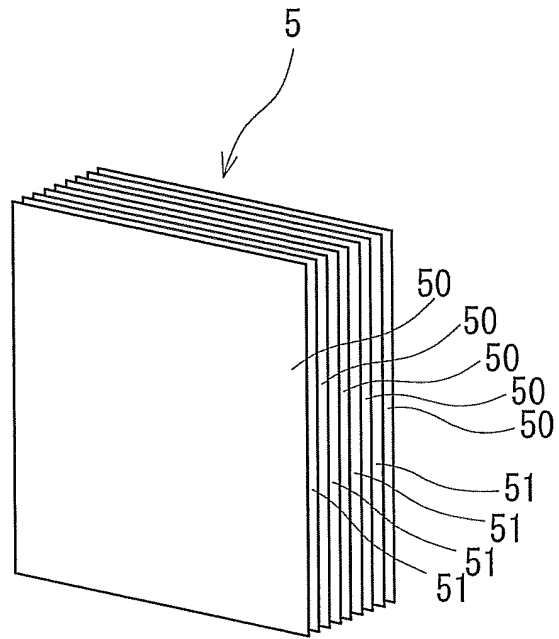


FIG. 5

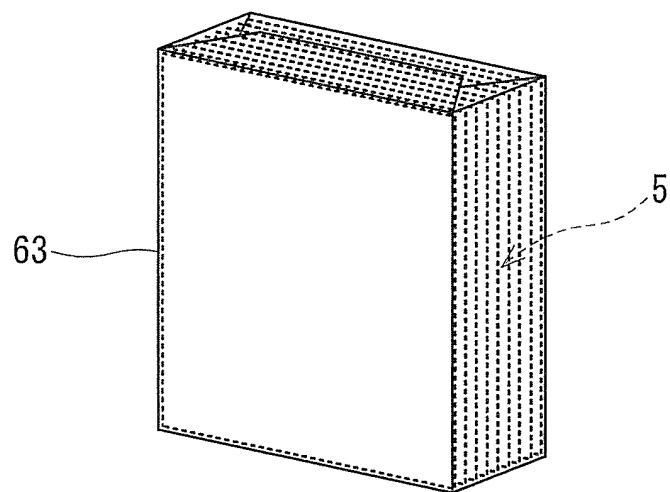


FIG. 6

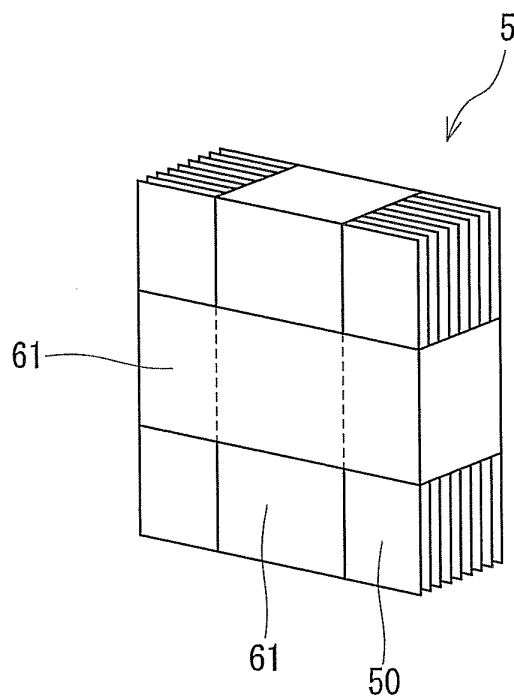


FIG. 7

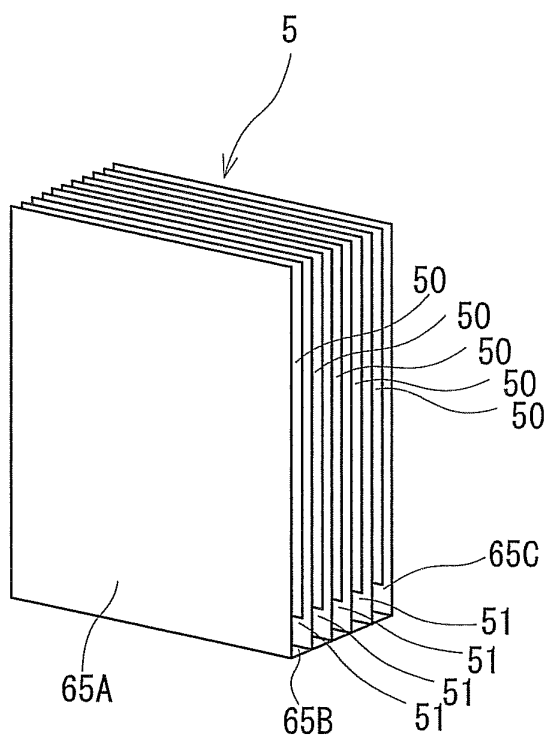


FIG. 8

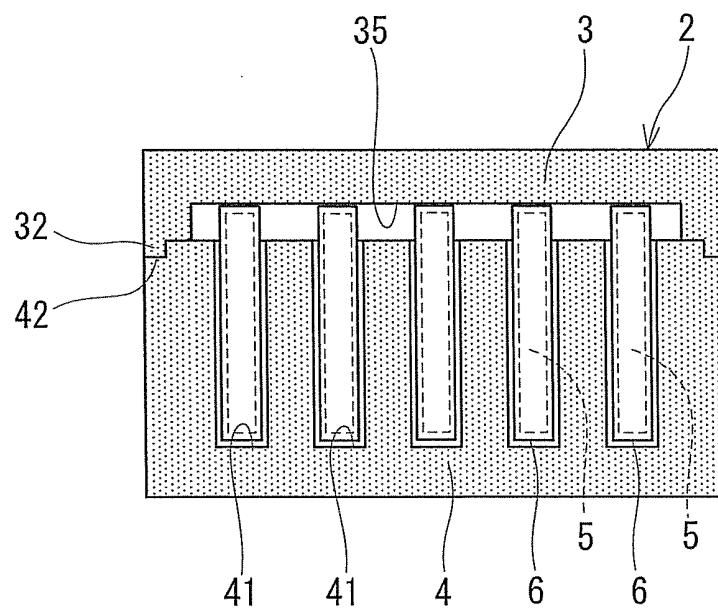


FIG. 9

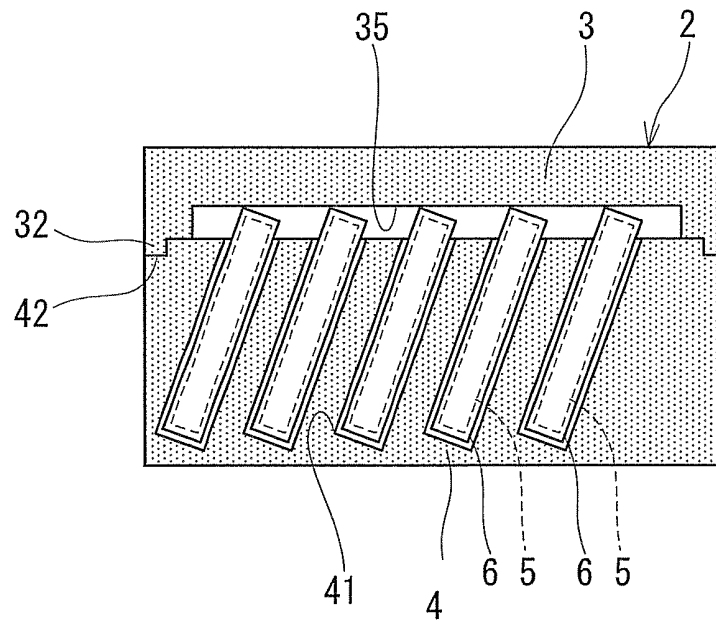


FIG. 10

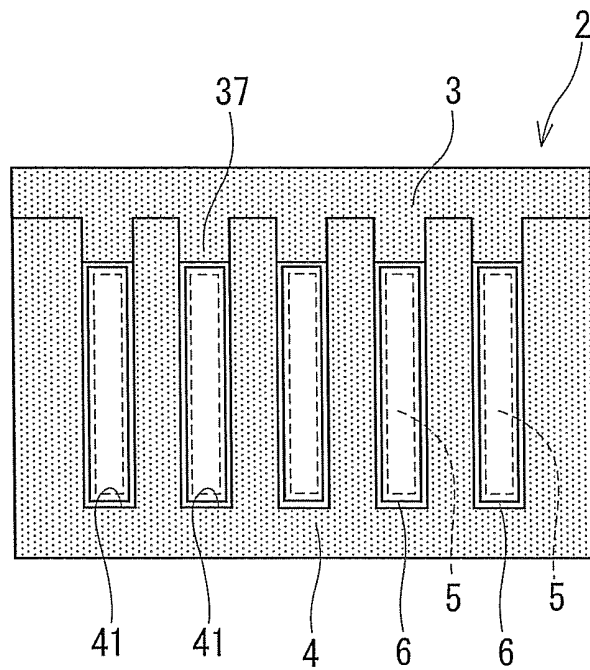


FIG.11

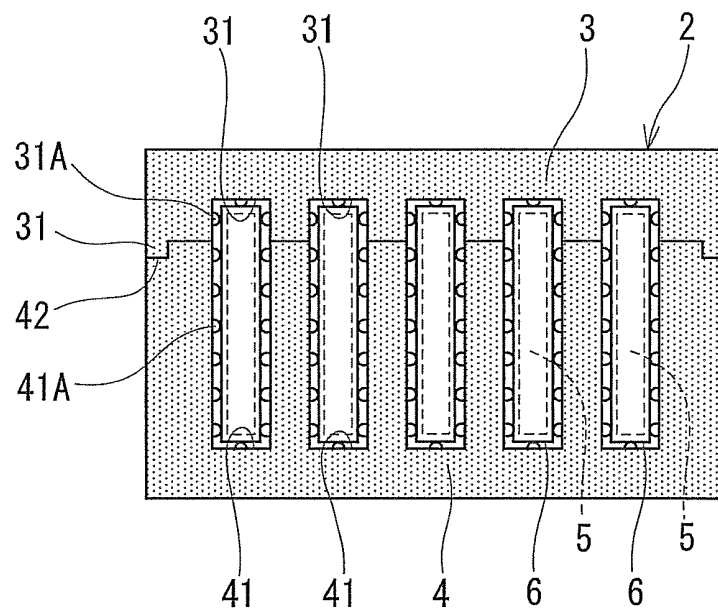


FIG.12

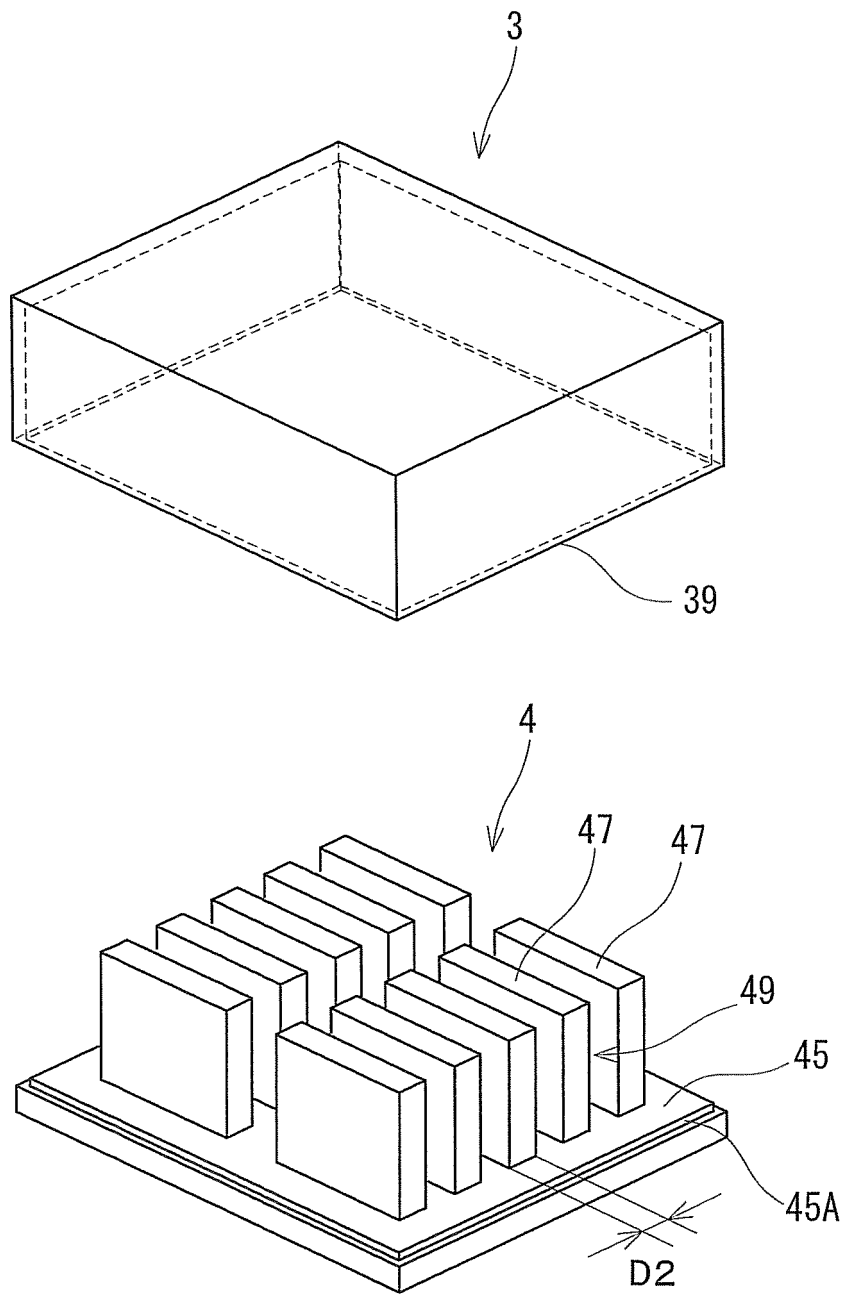


FIG.13

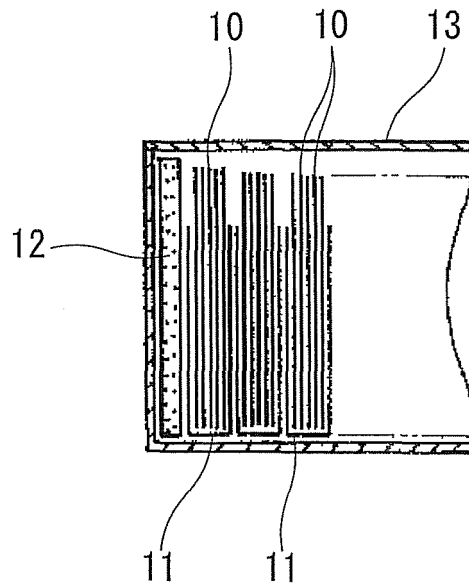


FIG.14A

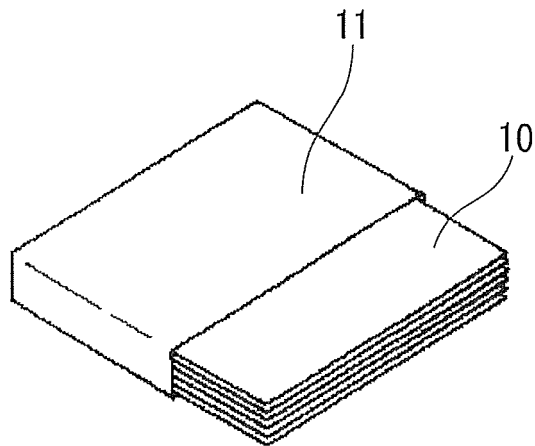


FIG.14B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/000213

A. CLASSIFICATION OF SUBJECT MATTER

B65D85/86(2006.01)i, B65D77/04(2006.01)i, B65D81/113(2006.01)i, B65D85/44(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B65D85/86, B65D77/04, B65D81/113, B65D85/44

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013

Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 2006/104169 A1 (Kyocera Corp.), 05 October 2006 (05.10.2006), paragraphs [0002], [0058] to [0068], [0097], [0118]; fig. 1 to 3, 9, 18 & CN 101156249 A & DE 112006000773 T5 & JP 5042819 B2 & US 2008/0251114 A1	1-2, 4, 6-8, 10 3, 5, 9
Y	JP 2005-231704 A (Sealed Air Japan Kabushiki Kaisha), 02 September 2005 (02.09.2005), claim 1; paragraphs [0010] to [0014]; fig. 1 to 2 (Family:none)	3, 5

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

09 April, 2013 (09.04.13)

Date of mailing of the international search report

23 April, 2013 (23.04.13)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/000213

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 087319/1992 (Laid-open No. 051172/1994) (Nippon Electric Glass Co., Ltd.), 12 July 1994 (12.07.1994), paragraph [0011]; fig. 1 (Family: none)	9

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/000213

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The matter common to the inventions of claims 1 to 10 is the configuration of the package body specified by claim 1.

However, the above-said configuration is not a special technical feature within the meaning of PCT Rule 13.2, second sentence, since said configuration is disclosed in WO 2006/104169 A1 (Kyocera Corp.), 05 October 2006 (05.10.2006), paragraphs [0002], [0058] to [0068], [0097], [0118]; fig. 1 to 3, 9, 18, and therefore does not make a contribution over the prior art.
(Continued to extra sheet)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/000213

Continuation of Box No.III of continuation of first sheet (2)

Consequently, since there is no other common matter, which is considered to be a special technical feature within the meaning of PCT Rule 13.2, second sentence, among the inventions of claims 1-10, any technical relationship within the meaning of PCT Rule 13 cannot be found among these inventions.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2000226087 A [0003]