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(54) **TRAY FOR LARGE-SIZE SEMICONDUCTOR INTEGRATED CIRCUITS**

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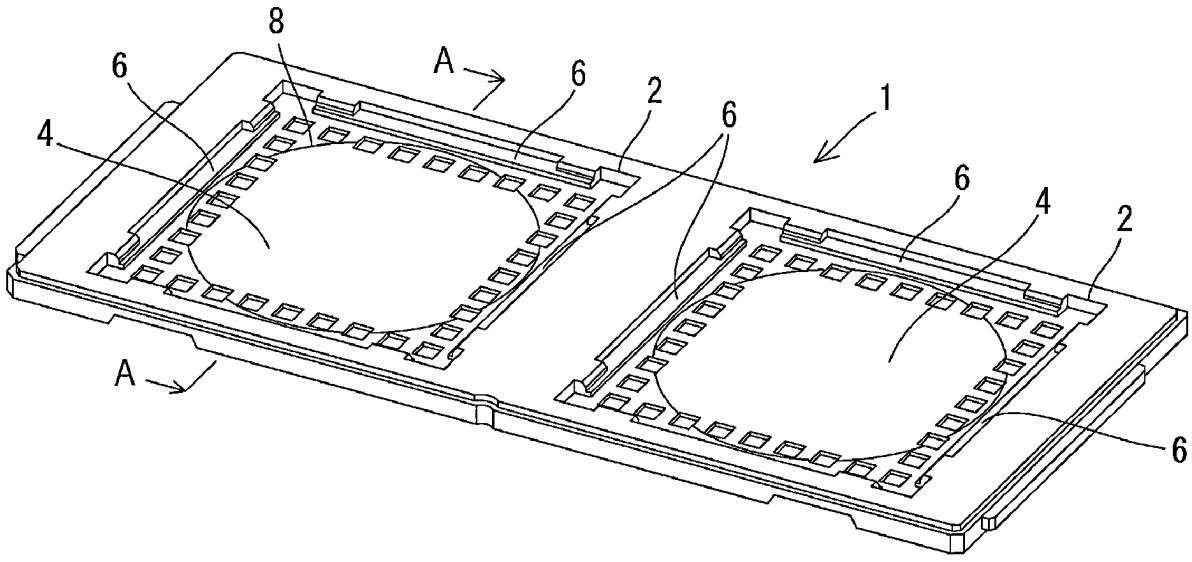
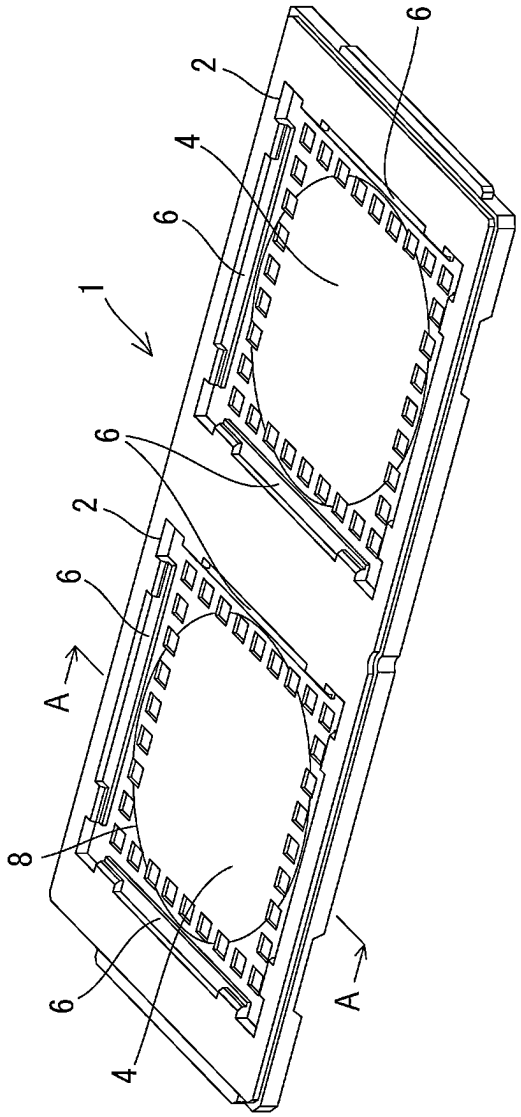
(57) **ABSTRACT**

A tray **1** for large-size semiconductor integrated circuits comprises one or a plurality of pockets **2** for accommodating large-size semiconductor integrated circuits is provided. On the inner bottom surface **4** of each of the pockets, a rounded recess **10** having a circular outline **8** is formed. The circular outline **8** is generally concentric with the center of each of the pockets. The rounded recess **10** formed on the inner bottom surface **4** of a pocket **2** prevents the inner bottom surface **4** from contacting terminals on the bottom face of a semiconductor integrated circuit to be placed in the pocket.

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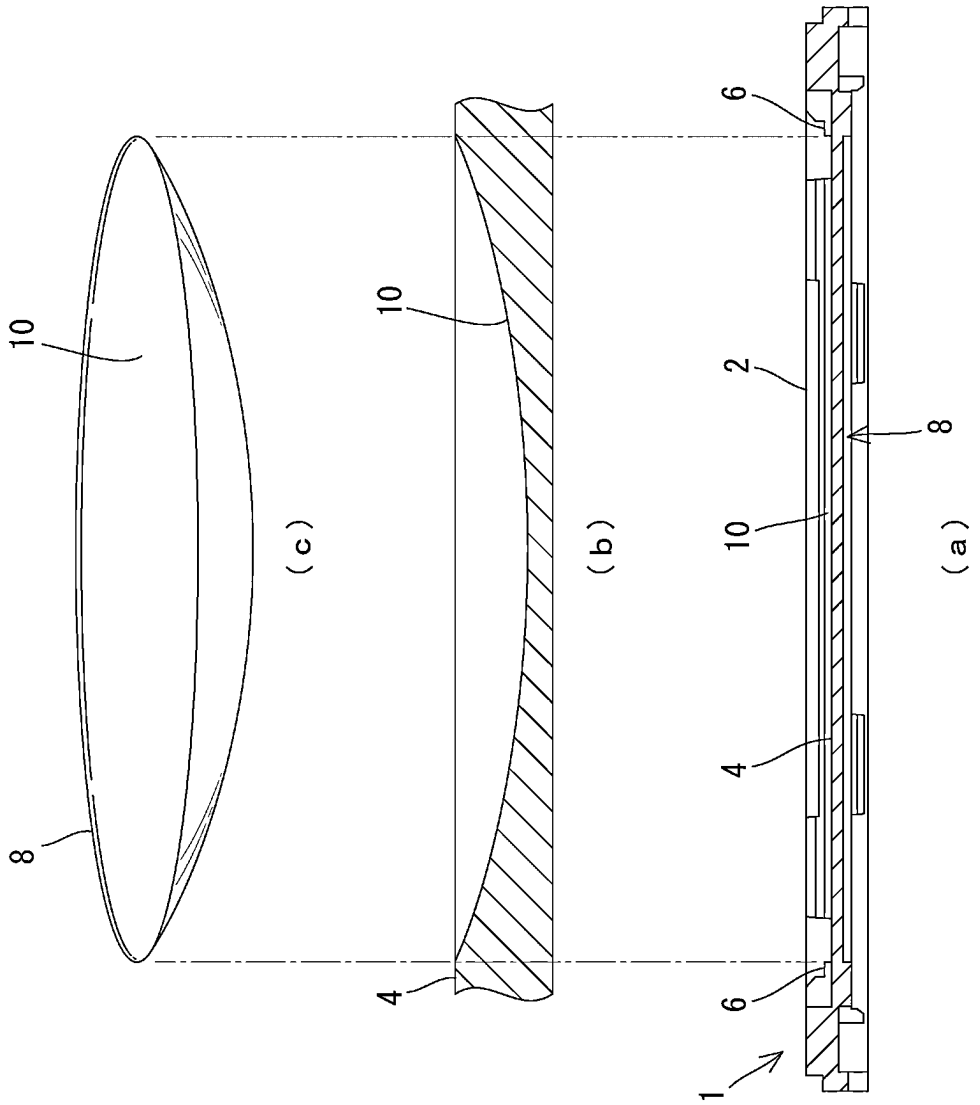
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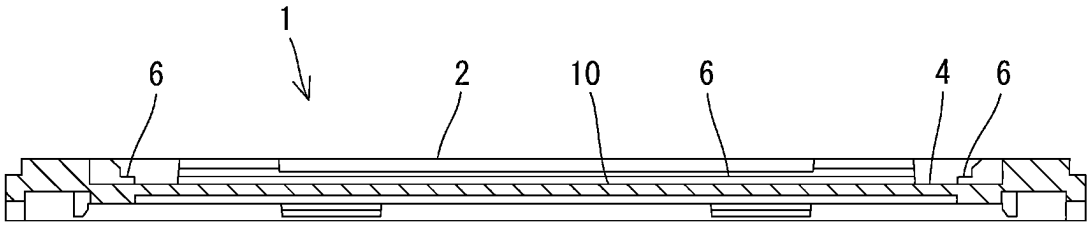

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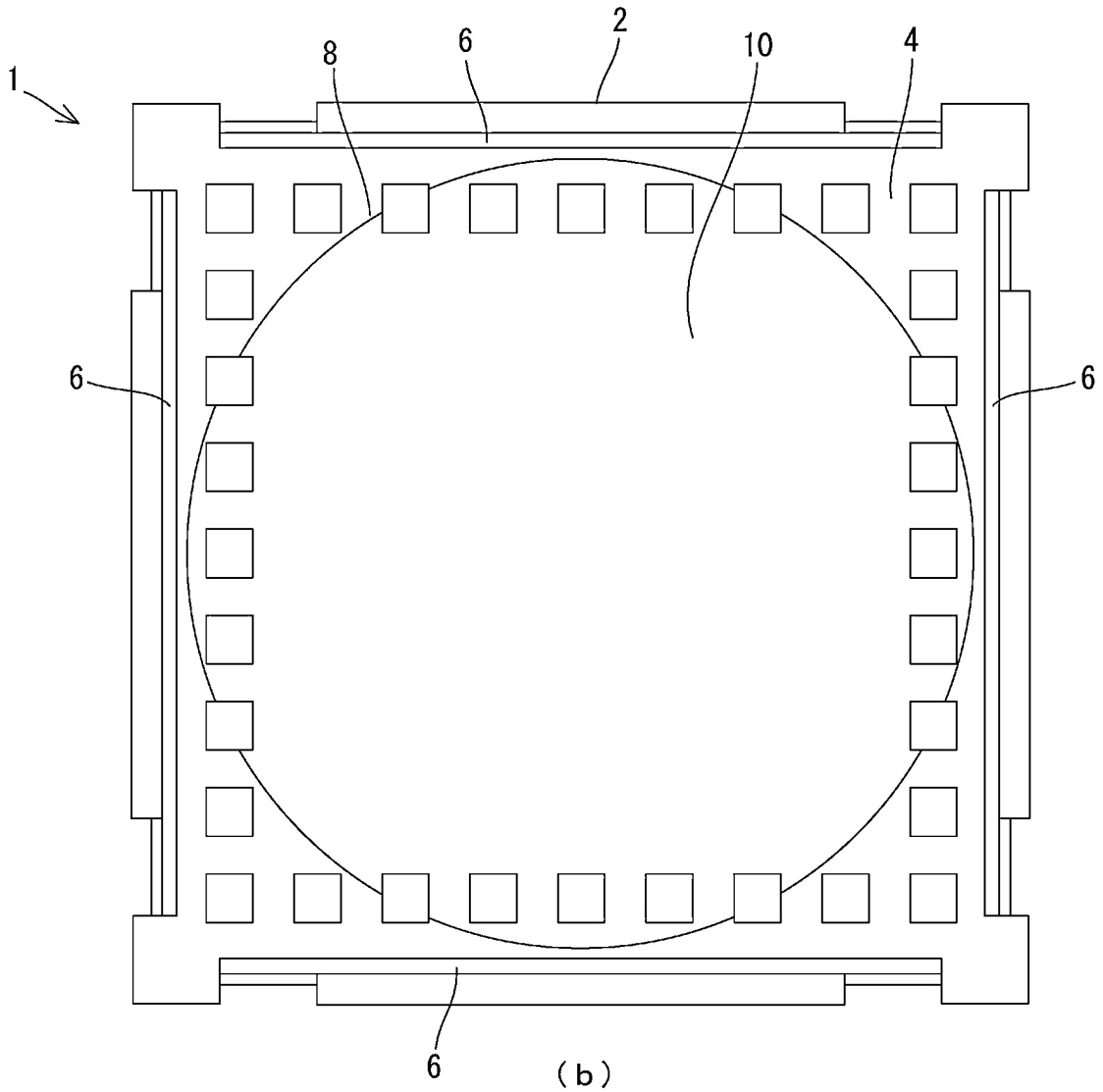

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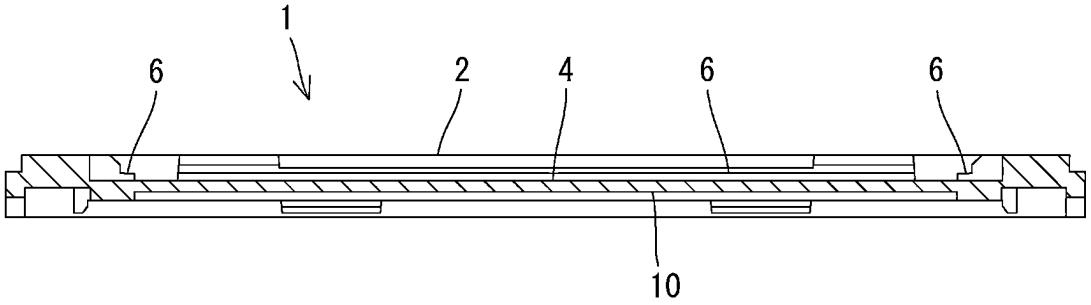

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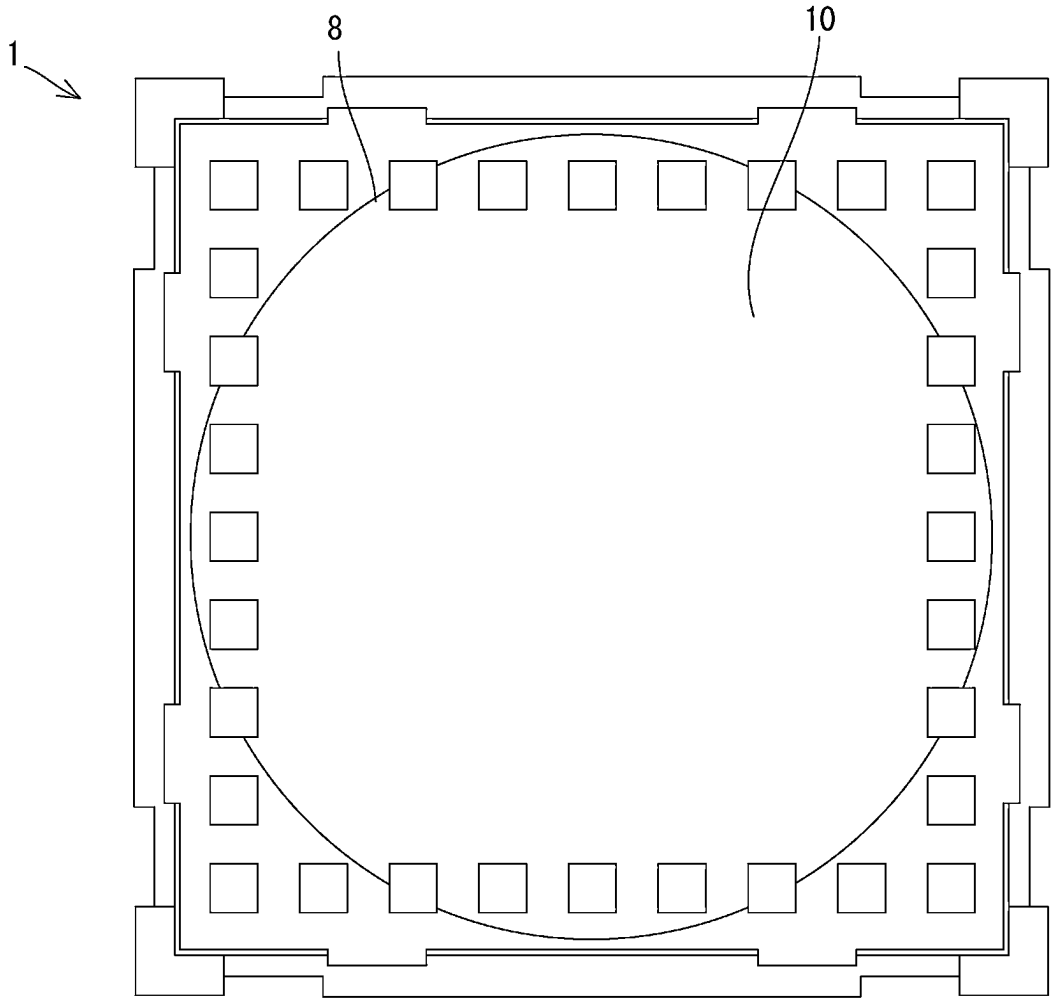

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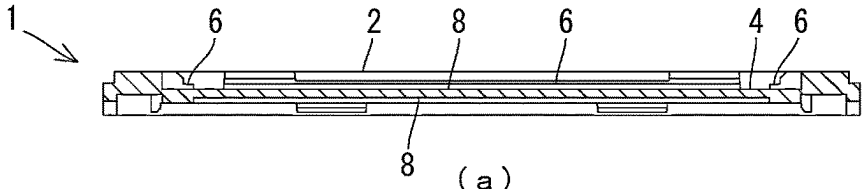

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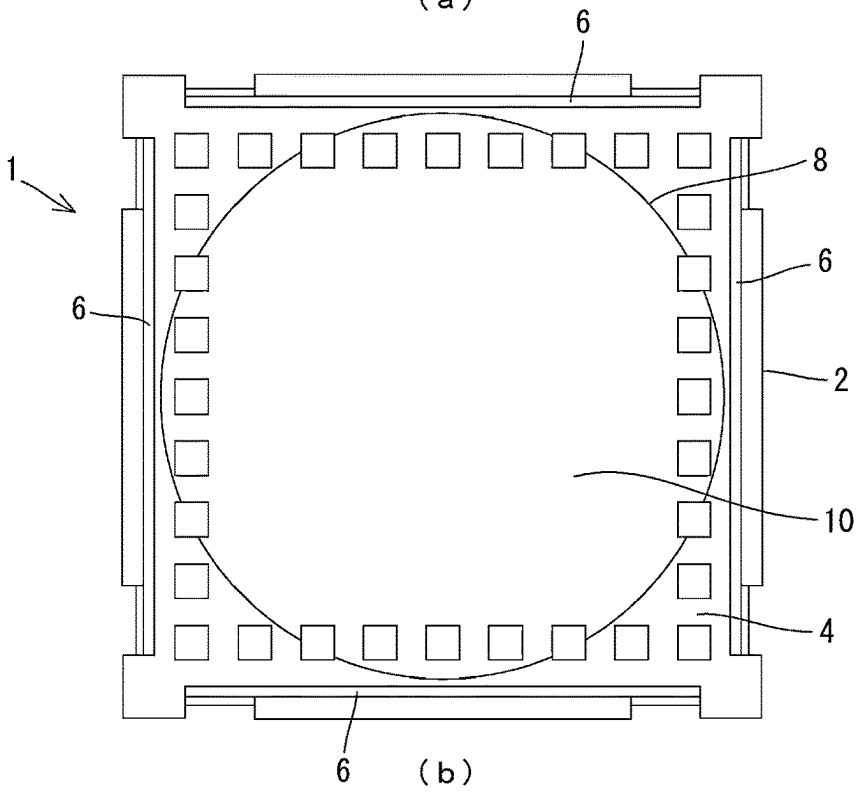

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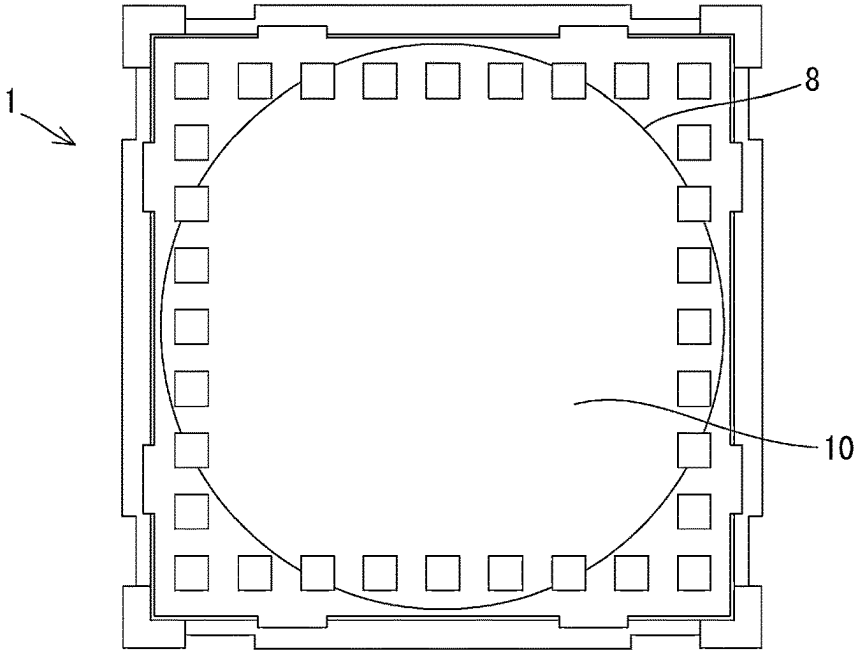

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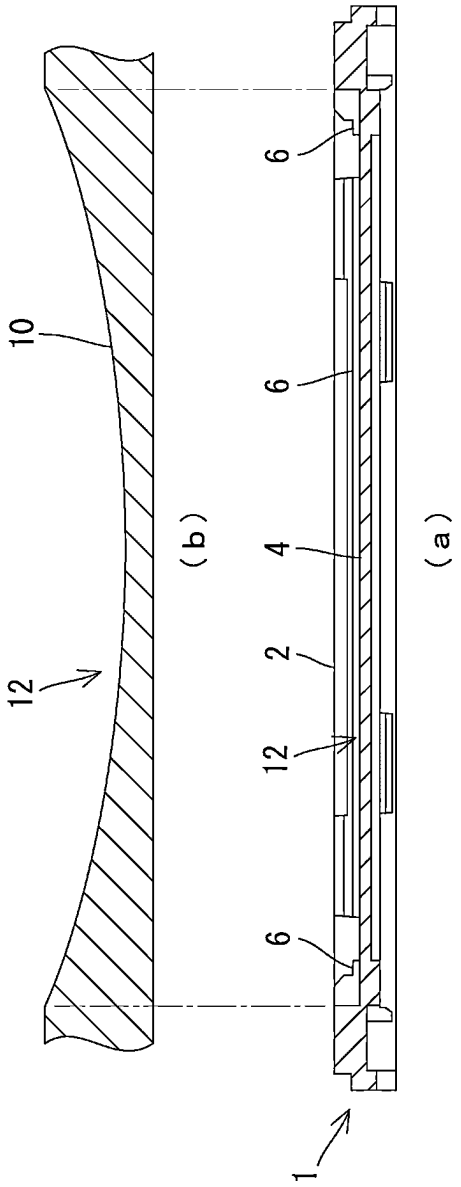
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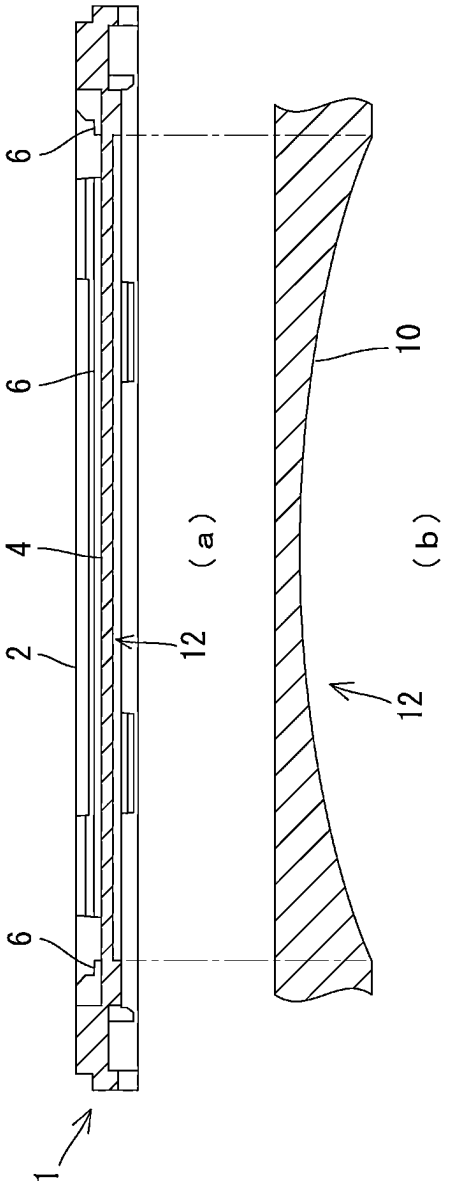
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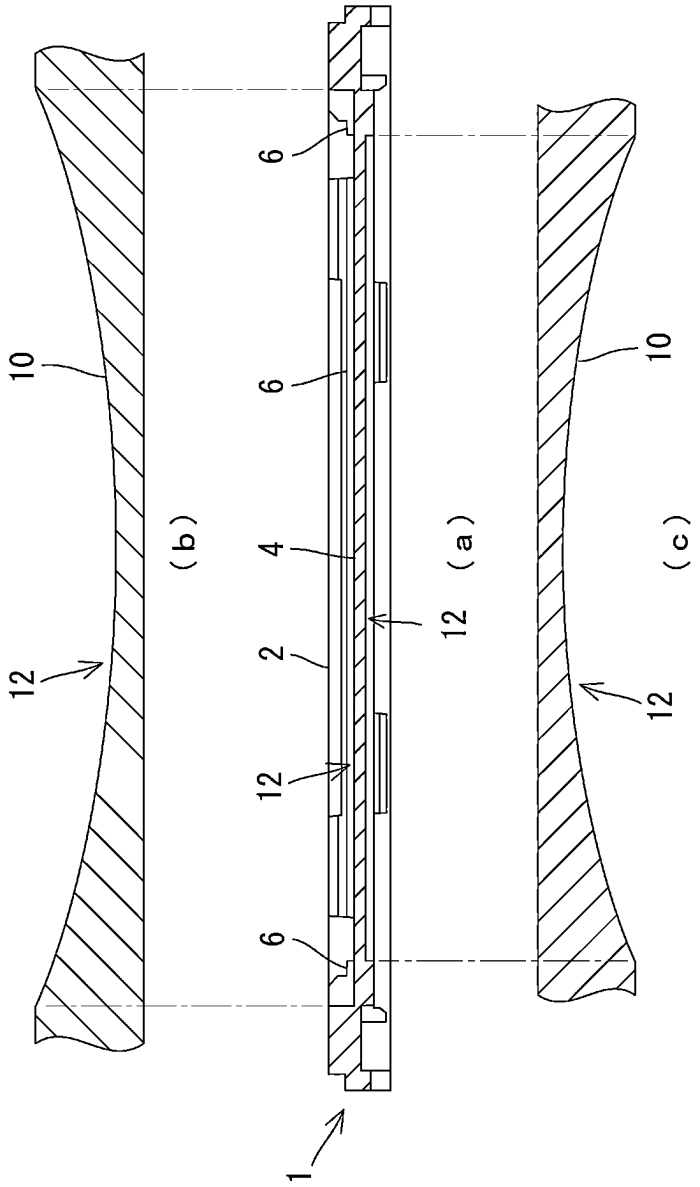
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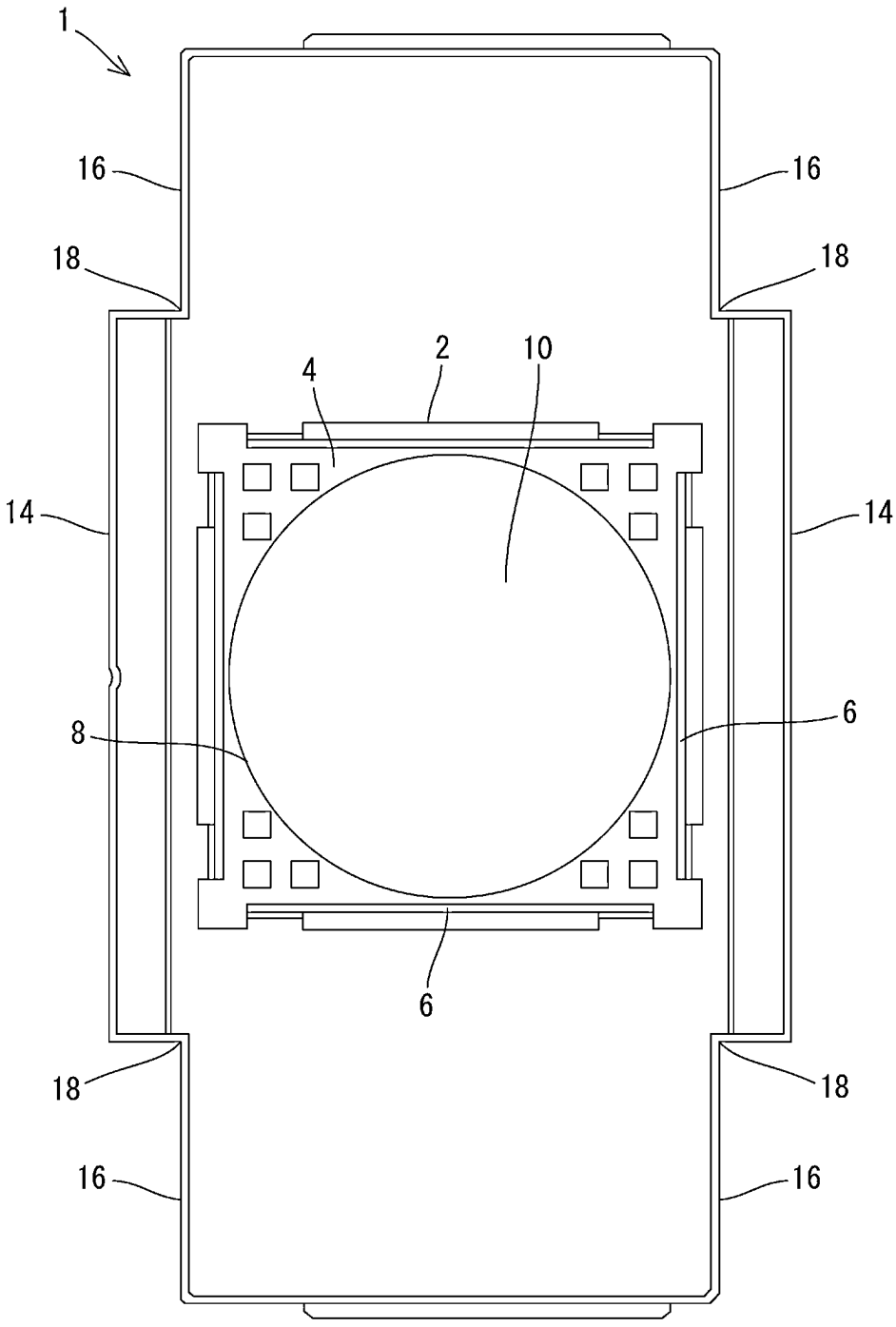
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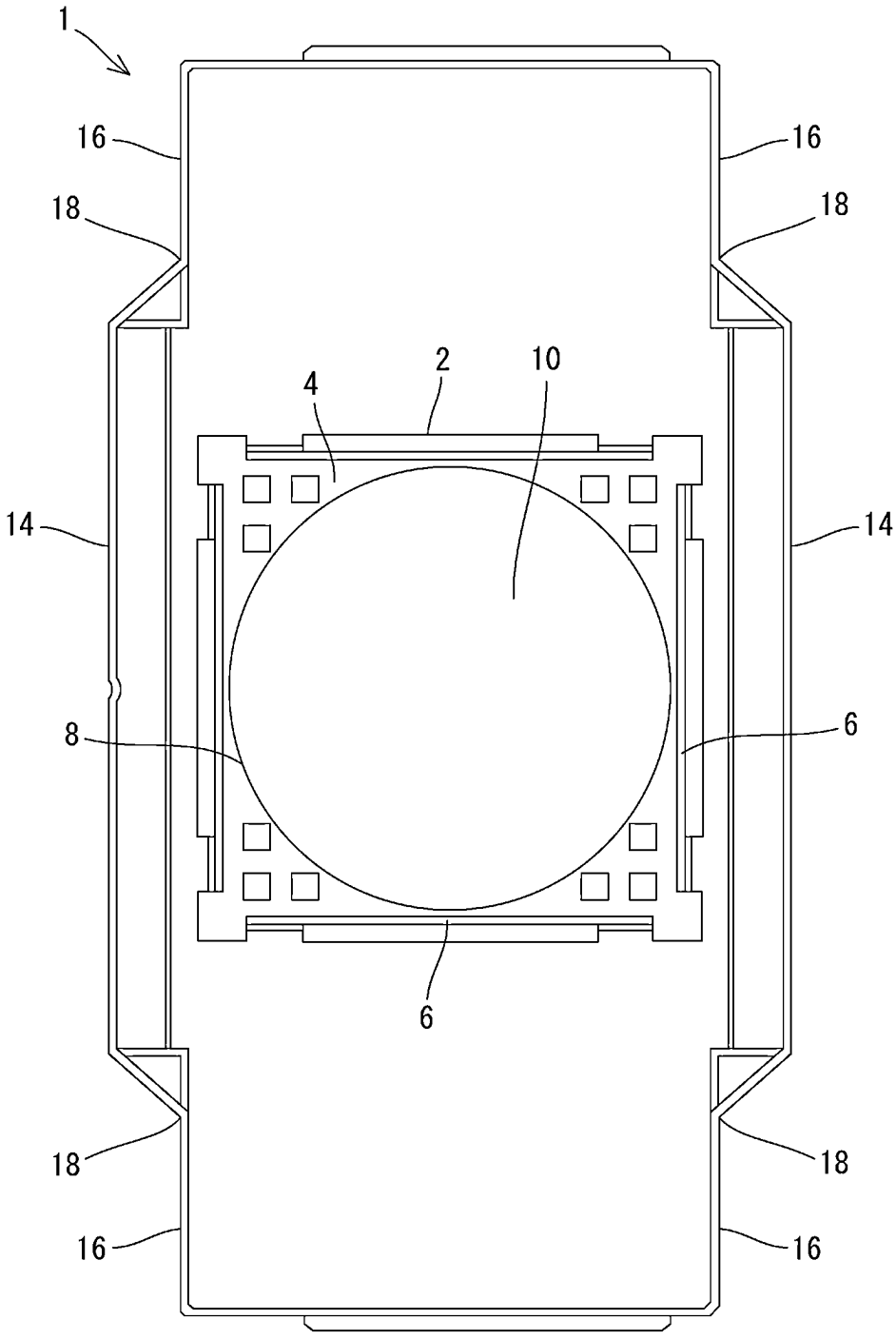
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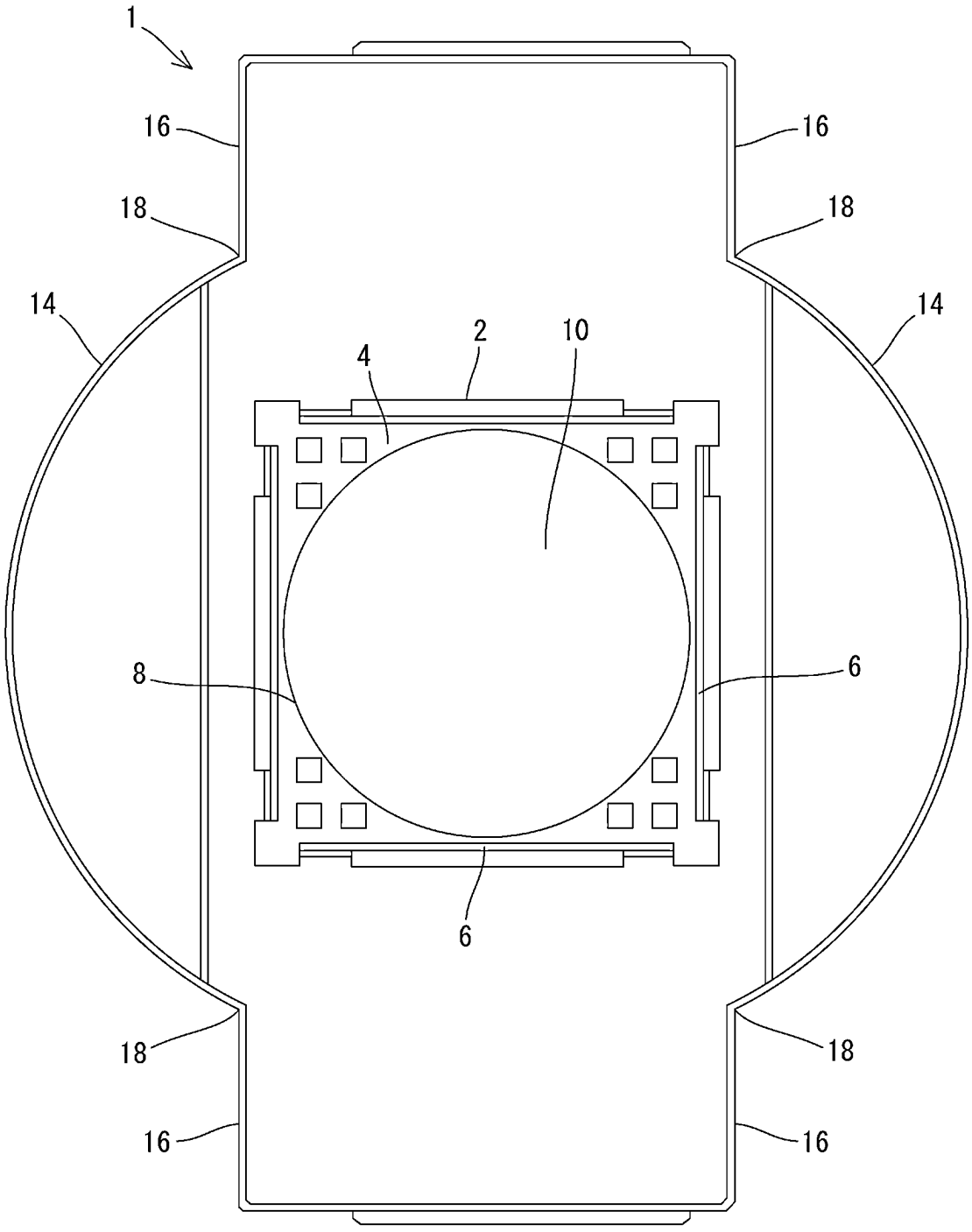
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TRAY FOR LARGE-SIZE SEMICONDUCTOR INTEGRATED CIRCUITS

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a tray for substrates of semiconductor integrated circuits such as ICs, and more specifically, the present invention relates to a tray that is suitable for accommodating substantially large-size semiconductor integrated circuits (including semiconductor packages) which have multiple terminals on the bottom face thereof.

2. Description of Related Art

[0002] A tray for semiconductor integrated circuits (hereinafter also referred to as just "a tray") is provided with one or a plurality of pockets to accommodate substrates of semiconductor integrated circuits. In addition, a tray for semiconductor integrated circuits is provided with supporting steps that extend horizontally along a pocket of the tray so that the supporting steps support a semiconductor integrated circuit and prevent the inner bottom surface of the pocket from contacting terminals on the bottom face of the semiconductor integrated circuit even if a grid array type (such as PGA-type, BGA-type and so forth) semiconductor integrated circuit is placed in the pocket.

[0003] A tray that is pursuant to JEDEC (Electron Device Engineering Council) standard has horizontal and vertical dimensions ([longitudinal size]×[lateral size]) of [315.0 mm-322.6 mm (approx. 12.4 in-12.7 in.)]×[135.9 mm (approx. 5.35 in.)] and can be manipulated through conventional automated machinery for JEDEC standard trays.

[0004] However, some substrates of large-size semiconductor integrated circuits may have some deformation caused by erroneous manufacture. Alternatively, when a substrate of a semiconductor integrated circuit happens to be deflected fortuitously, terminals on the bottom face of the semiconductor integrated circuit may contact the inner bottom surface of a pocket of the tray.

[0005] Japanese Patent Application Publication No. 2022-142375 discloses a recess on the inner bottom surface of a pocket of a tray, the recess having a flat surface which is approximately analogous to the bottom surface of a semiconductor integrated circuit and having a longer depth than a height of a terminal provided on the bottom face of a semiconductor integrated circuit.

[0006] When a tray for large-size semiconductor integrated circuits which is as large as the upper limit of the size of JEDEC standard happens to be deflected, the inner bottom surface of a pocket on the tray may contact terminals on the bottom face of a semiconductor integrated circuit which is to be placed in the pocket. In addition, it has been difficult for conventional automated machinery for JEDEC standard trays to manipulate a tray for large-size semiconductor integrated circuits having horizontal and vertical dimensions of 120×120 mm (approx. 4.72×4.72 in.) or larger in planar view.

SUMMARY OF THE INVENTION

[0007] A tray for large-size semiconductor integrated circuits that comprises one or a plurality of pockets for accommodating large-size semiconductor integrated circuits is provided. A rounded recess having a circular outline is formed on the inner bottom surface of each of the pockets.

[0008] In one embodiment, the circular outline is generally concentric with the center of each of the pockets.

[0009] In one embodiment, a rounded recess having a circular outline is formed on the opposite side of the inner bottom surface of each of the pockets.

[0010] In one embodiment, the circular outline on the opposite side is generally concentric with the center of each of the pockets.

[0011] In one embodiment, the rounded recess is comprised of a spherical dome having a predetermined radius of curvature.

[0012] In one embodiment, the tray has protruding portions that extend laterally from longitudinal side walls of the tray.

[0013] In one embodiment, each of the protruding portions has a generally rectangular shape.

[0014] In another embodiment, each of the protruding portions has a generally trapezoidal shape.

[0015] In still another embodiment, each of the protruding portions has a generally arcuate shape.

[0016] In one embodiment, the protruding portions are arranged at positions which are predetermined distance away from the longitudinal side ends of the tray.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** is a plan view illustrating an example of a tray for semiconductor integrated circuits according to the present invention.

[0018] FIG. **2** is an enlarged plan view of a pocket of the tray for semiconductor integrated circuits in FIG. **1**.

[0019] FIG. **3** illustrates a tray with a rounded recess formed on the inner bottom surface of a pocket of the tray.

[0020] FIG. **4** illustrates a tray with a rounded recess formed on the opposite side of the inner bottom surface of a pocket of the tray.

[0021] FIG. **5** illustrates a tray with rounded recesses formed on the inner bottom surface and the opposite side of the inner bottom surface of a pocket of the tray.

[0022] FIG. **6** is a cross-sectional view illustrating an arched, rounded recess formed on the inner bottom surface of a pocket of the tray.

[0023] FIG. **7** is a cross-sectional view illustrating an arched, rounded recess formed on the opposite side of the inner bottom surface of a pocket of the tray.

[0024] FIG. **8** is a cross-sectional view illustrating arched, rounded recesses formed on the inner bottom surface and the opposite side of the inner bottom surface of a pocket of the tray.

[0025] FIG. **9** illustrates a tray provided with a protruding portion having a rectangular shape.

[0026] FIG. **10** illustrates a tray provided with a protruding portion having a trapezoidal shape.

[0027] FIG. **11** illustrates a tray provided with a protruding portion having an arcuate shape.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Hereinafter, an example tray for large-size semiconductor integrated circuits according to the present invention will be described in detail based on embodiments which are illustrated in the attached drawings.

[0029] FIG. **1** is a perspective view of an example tray **1** for semiconductor integrated circuits. The upper surface of a tray **1** is provided with one or a plurality of pockets **2** depending on the figuration and size of semiconductor integrated circuits which are to be placed in pockets **2** of the tray **1**. In addition, a pocket **2** is provided with supporting steps **6** that extend horizontally along the inner side walls of the pocket **2** for supporting edges of a semiconductor integrated circuit and prevent the inner bottom surface **4** of the pocket **2** from contacting terminals **7** on the bottom face **4** of the semiconductor integrated circuit.

[0030] As illustrated in FIG. **1**, a rounded recess **10** having a circular outline **8** is formed on the inner bottom surface of each of two pockets **2** on the upper surface of the tray **1**.

[0031] FIG. **2**(*a*) is a sectional view taken along line A-A in FIG. **1**.

[0032] FIG. **2**(*b*) illustrates a tray **1** so exaggeratingly as to clarify a rounded recess **10** although a real rounded recess **10** is too slightly rounded for the naked eye to see. As illustrated in FIG. **2**(*b*), a rounded recess **10** may be formed on the inner bottom surface **4** of a pocket **2** of the tray **1**.

[0033] FIG. **2**(*c*) is a perspective view showing that the rounded recess **10** is comprised of a turned spherical dome (a sphere segment taken along the inner bottom surface **4**). FIG. **2**(*c*) exaggeratingly illustrates a tray **1** so that the rounded surface of a spherical dome can be seen clearly. As illustrated, the rounded recess **10** formed on the inner bottom surface **4** of a pocket **2** prevents the inner bottom surface **4** from contacting terminals on the bottom face (especially terminals around the center of the substrate) of a semiconductor integrated circuit which is to be placed in the pocket **2**. The dashed-dotted lines across FIGS. **2**(*a*)-(*c*) indicate mutually corresponding points.

[0034] FIG. **3** illustrates an example tray **1**. FIG. **3**(*a*) is a cross-sectional view taken along line A-A in FIG. **1**. FIG. **3**(*b*) illustrates a rounded recess **10** formed on the inner bottom surface **4** of a pocket **2** of the tray **1**. FIG. **3**(*b*) further illustrates a circular outline **8** of the rounded recess **10** in the pocket **2** wherein the circular outline **8** is generally concentric with the center of the pocket **2** (i.e. two diagonal lines to the opposite corners of the pocket **2** intersect each other at the center of the circular outline). In one embodiment, a circular outline **8** has a radius as illustrated while in another embodiment, a circular outline **8** may have a different radius. In some embodiments, the rounded recess **10** is comprised of a spherical dome (a spherical segment taken along the inner bottom surface **4**) having a predetermined radius of curvature within a range from 1000 mm to 5000 mm (from approx. 39.37 in. to approx. 196.9 in.). For example, the predetermined radius of curvature is 3000 mm (approx. 118.1 in.).

[0035] FIG. **4** illustrates another example tray **1**. FIG. **4**(*a*) is a cross-sectional view taken along line A-A in FIG. **1**. As illustrated in FIG. **4**(*b*), a rounded recess **10** is formed on the opposite side of the inner bottom surface of a pocket **2** of the tray **1**. FIG. **4**(*b*) further illustrates a circular outline **8** of the rounded recess **10** wherein the circular outline **8** is generally concentric with the center of the pocket **2**. In some embodiments, the rounded recess **10** is comprised of a spherical dome (a spherical segment taken along the lower side of the tray **1**) having a predetermined radius of curvature.

[0036] FIG. **5** illustrates still another example tray **1**. FIG. **5**(*a*) is a cross-sectional view taken along line A-A in FIG. **1**. In this example, rounded recesses **10** are formed on the upper and lower surfaces of the tray **1** as illustrated in FIGS. **5**(*b*)-(*c*). FIG. **5**(*b*) shows a rounded recess **10** formed on the inner bottom surface **4** of a pocket **2** of the tray **1**. FIG. **5**(*c*) shows a rounded recess **10** formed on the opposite side of the inner bottom surface **4** of the pocket **2**. FIGS. **5**(*b*)-(*c*) further show circular outlines **8** of the rounded recesses **10** which are generally concentric with the center of the pocket **2**. With such a structure, the tray **1** can resist a force in the bending direction of the tray **1** in spite of its thinness and avoid deformation (warpage, deflection and so forth) of the substrate of the tray **1** when large-size semiconductor integrated circuits **6** are packed in the tray **1**.

[0037] FIG. **6** illustrates a first embodiment of the present invention. FIG. **6**(*a*) is a cross-sectional view taken along line A-A in FIG. **1**. FIG. **6**(*b*) is a cross-sectional view exaggeratingly illustrating an arched, rounded recess **10** formed on the inner bottom surface **4** of a pocket **2** of the tray **1**. Such a rounded recess **10** formed on the inner bottom surface **4** of a pocket **2** prevents the inner bottom surface **4** from contacting terminals on the bottom face (especially terminals around the center of the substrate) of a semiconductor integrated circuit which is to be placed in the pocket **2**.

[0038] FIG. **7** illustrates a second embodiment of the present invention. FIG. **7**(*a*) is a cross-sectional view taken along line A-A in FIG. **1**. FIG. **7**(*b*) is a cross-sectional view **12** exaggeratingly illustrating an arched, rounded recess **10** on the opposite side of the inner bottom surface **4** of a pocket **2** of a tray **1**. In spite of its thinness, the tray **1** is rigid and hard to break because the weight of a substrate of semiconductor integrated circuit will be received by the bridged structure of a rounded recess **10** on the lower side of the tray **1**.

[0039] FIG. **8** illustrates a third embodiment of the present invention. FIG. **8**(*a*) is a cross-sectional view **12** taken along line A-A in FIG. **1**. FIG. **8**(*b*) is a cross-sectional view **12** illustrating an arched, rounded recess **10** on the inner bottom surface **4** of a pocket **2** of the tray **1**. FIG. **8**(*c*) is a cross-sectional view **12** illustrating an arched, rounded recess **10** on the opposite side of the inner bottom surface **4** of the pocket **2**. FIGS. **8**(*b*)-(*c*) illustrate the tray **1** exaggeratingly so that a bridged structure (an arch construction) can be seen clearly.

[0040] The tray **1** illustrated in FIGS. **9-11** has protruding portions **14**. The protruding portions **14** may enable a pocket **2** of the tray **1** to accommodate a semiconductor integrated circuit having horizontal and vertical dimensions of 120×120 mm (approx. 4.72×4.72 in.) or larger in planar view. The figuration and dimensions of the protruding portions **14** may be designed depending on the size, weight and so forth of semiconductor integrated circuits which are to be placed in pockets **2** of the tray **1**. The protruding portions **14** may extend laterally from the longitudinal side walls **16** of the tray **1**.

[0041] FIG. **9** illustrates protruding portions **14** in a first embodiment, each of which has a generally rectangular shape. FIG. **9** further illustrates positions **18** beyond which the protruding portions **14** extend laterally from the longitudinal side walls **16** of the tray **1**, which makes a cross-like figure as illustrated. Those positions **18** are predetermined distance away from the longitudinal side ends (i.e. corner edges) of the tray **1**. The positions **18** should be from 20 to 70 mm (approx. from 0.79 to 2.76 in.) away from the longitudinal side ends of the tray **1**, which makes possible

for conventional automated machinery for JEDEC standard trays to manipulate the tray **1** with those protruding portions **14** though the tray **1** with those protruding portions **14** is, technically speaking, not pursuant to JEDEC standard.

[0042] FIG. **10** illustrates protruding portions **14** in a second embodiment, each of which has a generally trapezoidal shape.

[0043] FIG. **11** illustrates protruding portions **14** in a third embodiment, each of which has a generally arcuate shape outlined by an arc (whose central angle is less than 180 degrees) and a subtense that connects two ends of the arc.

REFERENCE SIGNS LIST

[0044] **1** tray
[0045] **2** pocket
[0046] **4** inner bottom surface
[0047] **6** supporting step
[0048] **8** circular outline
[0049] **10** rounded recess
[0050] **12** arched cross-section
[0051] **14** protruding portion
[0052] **16** longitudinal side wall
[0053] **18** position predetermined distance away from a corner

1. A tray for large-size semiconductor integrated circuits that comprises:
one or a plurality of pockets for accommodating large-size semiconductor integrated circuits;
wherein a rounded recess having a circular outline is formed on the inner bottom surface of each of the pockets.

2. The tray for large-size semiconductor integrated circuits according to claim **1**,
wherein the circular outline is generally concentric with the center of each of the pockets.

3. The tray for large-size semiconductor integrated circuits according to claim **2**,
wherein a rounded recess having a circular outline is formed on the opposite side of the inner bottom surface of each of the pockets.

4. The tray for large-size semiconductor integrated circuits according to claim **3**,
wherein the circular outline on the opposite side is generally concentric with the center of each of the pockets.

5. The tray for large-size semiconductor integrated circuits according to claim **1**,
wherein the rounded recess is comprised of a spherical dome having a predetermined radius of curvature.

6. The tray for large-size semiconductor integrated circuits according to claim **1**,
wherein the tray has protruding portions that extend laterally from longitudinal side walls of the tray.

7. The tray for large-size semiconductor integrated circuits according to claim **6**,
wherein each of the protruding portions has a generally rectangular shape.

8. The tray for large-size semiconductor integrated circuits according to claim **6**,
wherein each of the protruding portions has a generally trapezoidal shape.

9. The tray for large-size semiconductor integrated circuits according to claim **6**,
wherein each of the protruding portions has a generally arcuate shape.

10. The tray for large-size semiconductor integrated circuits according to claim **6**,
wherein each of the protruding portions has a generally rectangular shape, a generally trapezoidal shape, or a generally arcuate shape; and
wherein the protruding portions are arranged at positions which are predetermined distance away from the longitudinal side ends of the tray.

* * * * *