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[54]	Title:	METHOD FOR PRODUCING LEAD FRAME AND LEAD FRAME		
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[57]	Abstract:	Provided is a method for producing a lead frame, by which a vertical gap generated between separate die pads can be reduced. The method for producing a lead frame 1 according to the present disclosure includes, in sequence set forth, the steps of (A) processing a processing material 80 into a shape of a lead frame including a die pad portion, (B) depressing the processing material (80), and (C) dividing the die pad portion to form separate die pads 21, 22.		

each inner leads 31, 32, 33, 34 includes three leads extending in the Y-direction. Of three leads arranged in parallel as the inner leads 31, only the middle lead is connected to the separate die pad 21 (specifically, to a center portion of the separate die pad 21 in the X-direction on one end side in the Y-direction). Similarly, of three leads as the inner leads 32, only the middle lead is connected to the separate die pad 22 (specifically, to a center portion of the separate die pad 22 in the X-direction on one end side in the Y-direction). Of three leads arranged in parallel as the inner leads 33, only the outer lead is connected to the separate die pad 21 (specifically, to an outer portion of the separate die pad 21 in the X-direction on the other end side in the Y-direction). Similarly, of three leads as the inner leads 34, only the outer lead is connected to the separate die pad 22 (specifically, to an outer portion of the separate die pad 22 in the X-direction on the other end side in the Y-direction). In the lead frame 1, ones of the inner leads 31, 32, 33, 34 connected to the die pad 12 are bent in a direction (a height direction, more specifically a downward direction) crossing the X-direction and the Y-direction by depressing (described later in detail). Thus, the die pad 12 is displaced downward by a predetermined height. By depressing, the semiconductor element mounted on the die pad 12 and tip ends of the inner leads 13 can be arranged on the same plane. The tip ends of the inner leads 13 are connected to the semiconductor element by wire bonding using a gold wire etc.

The outer leads 14 arranged outside the inner leads 13 in the Y-direction connect the inner leads 13 and the external wiring to each other. The outer leads 14 include outer leads 41 including a lead connected to each lead of the inner leads 31, outer leads 42 including a lead connected to each lead of the inner leads 32, outer leads 43 including a lead connected to each lead of the inner leads 33, and outer leads 44 including a lead connected to each lead of the inner leads 34.

The slits 15 are arranged at both end portions of the lead frame 1 in the Y-direction. The slits 15 are punched portions formed in the lead frame 1 across a substantially entire area in the X-direction. The slits 15 are formed inside guide holes 17 in the X-direction, the guide holes 17 being formed at four corners of the lead frame 1. The slits 15 are formed for stress absorption. Upon punching, pilot pins are inserted into the guide holes 17. The lead frame 1 might be distorted due to the stress generated on the both end sides in the Y-direction starting from the die pad 12 and the inner leads 13. In this case, a positional shift of the guide holes 17 with respect to the die pad 12 etc. might occur. In this case, the punching might be affected. On this point, the slits 15 are formed so that the stress generated on both end sides in the Y-direction starting from the die pad 12, the inner leads 13, etc. can be released through the slits 15. Thus, distortion of the lead frame 1, i.e., the positional shift of the guide holes 17 with respect to the die pad 12 etc., due to the above-described stress can be reduced.

The protruding portions 16 are arranged on the separate die pads 21, 22. The protruding portions 16 protrude in a direction in which the separate die pads 22, 21 face each other. The protruding portions 16 include protruding portions 61 and protruding portions 62. The protruding portions 61 are arranged at the both end portions in the Y-direction at a portion of the separate die pad 21 facing the separate die pad 22. The protruding portions 62 are arranged at the both end portions in the Y-direction at a portion of the separate die pad 22 facing the separate die pad 21. That is, the protruding portions 61 (first protruding portions) are arranged on the separate die pad 21, and protrude in the direction of facing the separate die pad 22. Moreover, the protruding portions 62 (second protruding portions) are arranged on the separate die pad 22, and protrude in the direction of facing the separate die pad 21. The protruding portions 61, 62 are the remaining portions of linking portions 90 (see Fig. 2(a), and the details will be described

later) left by the part of the linking portions 90 removed at the step of producing the lead frame 1. The protruding lengths of the protruding portions 61, 62 are very much shorter than any of the length of the lead frame 1 in the X-direction and the length of the separate die pad 21 (or the separate die pad 22) in the X-direction. For example, the protruding lengths of the protruding portions 61, 62 are set to 50 μm to 100 μm. Note that the protruding lengths of the protruding portions 61, 62 are described by way of example. These protruding lengths are not limited to this example.

[Method for Producing Lead Frame]

Next, the method for producing the lead frame 1 having the die pad 12 divided into portions (the separate die pads 21, 22) will be described with reference to Figs. 2(a) to 2(c) to Fig. 8. The lead frame 1 is produced through a lead frame shape formation step (the following step (A), see Fig. 2(a)), a depressing step (the following step (B), see Fig. 2(b)), and a linking portion cutting step (the following step (C), see Fig. 2(c)). More specifically, the method for producing the lead frame 1 as illustrated in Figs. 2(a) to 2(c) includes, in the sequence set forth, the following steps of:

(A) processing a band-shaped processing material 80 of a metal thin plate into a lead frame shape;

(B) depressing the processing material 80; and

(C) cutting the linking portions 90 of the processing material 80 to divide the die pad into the separate die pads 21, 22.

Note that in Figs. 2(a) to 2(c) illustrating the step of producing the lead frame 1, only the shape of a single lead frame 1 is illustrated for the sake of convenience in description. However, at step (A), the band-shaped processing material 80 is actually processed into a shape of multiple lead frames 1. Then, steps (B) and (C) are performed for the processing material 80 having the shape of multiple lead frames 1. Thereafter, a

packaging step is performed. Thereafter, the multiple lead frames 1 are separated from each other. At the packaging step, a semiconductor element is first die-bonded onto the separate die pads 21, 22 of the lead frame 1. Subsequently, the semiconductor element and the tip end of the inner leads 31, 32, 33, 34 are connected to each other by wire bonding. Finally, the separate die pads 21, 22 and the inner leads 31, 32, 33, 34 are, together with the semiconductor element, molded with thermosetting resin, for example.

First, step (A) is performed. At step (A), the processing material 80 is punched by punches of a die (a punching device), and in this manner, the lead frame shape is formed. The die sequentially punches the band-shaped processing material 80 intermittently sent in one direction by, for example, a pair of rollers (see Figs. 3(a) to 3(i)). Step (A) includes, in the sequence set forth, the following steps of:

(a-0) forming the guide holes 17 at the band-shaped processing material 80;

(a-1) forming the slits 15 at the processing material 80;

(a-2) forming the outer leads 14 at the processing material 80;

(a-3) forming the inner leads 13 at the processing material 80; and

(a-4) forming separating regions 210, 220 and the linking portions 90.

Step (A) will be described with reference to Figs. 3(a) to 3I to Fig. 8. Step (a-0) is a step of forming the guide holes 17 at both end portions of the band-shaped processing material 80 in a width direction (the Y-direction) (see Fig. 3(a) and Fig. 4(a)). The guide hole 17 is the hole into which the pilot pin for determining the position of the processing material 80 upon punching is inserted. At step (a-0), the punches of the die simultaneously punch the both end portions of the processing material 80 in the Y-direction, and in this manner, two guide holes 17 are formed simultaneously. The guide holes 17 are formed at the both end portions of the band-shaped processing material 80 in the Y-direction, the processing material 80 being intermittently sent by the rollers. In

this manner, the guide holes 17 are formed at the periphery (four corners) of the shape of single lead frame.

Step (a-1) is the step of forming the slits 15 extending in the X-direction at both end portions of the processing material 80 in the Y-direction (see Fig. 3(b) and Fig. 4(b)). More specifically, the slits 15 are formed along the X-direction inside the guide holes 17 formed at four corners of the lead frame 1. At step (a-1), the punches of the die simultaneously punch, along the X-direction, both end portions of the processing material 80 in the Y-direction. In this manner, two slits 15 extending in the X-direction are formed simultaneously.

At step (a-2), the outer leads 14 are formed along the Y-direction inside the slits 15 (see Figs. 3(c) and 3(d) and Figs. 5(a) and 5(b)). At step (a-2), the punches of the die first form, along the Y-direction, punched regions 45 at four spots inside each slit 15 formed at the both end portions in the Y-direction. Four punched regions 45 extend in the Y-direction by the same length, and are arranged at regular intervals along the X-direction (see Fig. 5(a)). Subsequently, the punches of the die form a single punched region 46 between adjacent ones of the punched regions 45. The punched regions 46 extend in the Y-direction by the same length as that of the punched region 45 (see Fig. 5(b)). That is, the punches of the die form three punched regions 46 on each end side in the Y-direction.

In this manner, as illustrated in Fig. 5(b), each outer lead 14 extending in the Y-direction is formed between adjacent ones of the punched regions 45, 46. More specifically, the outer leads 41 including three leads connected to the inner leads 31 (see Fig. 6(b)) and the outer leads 42 including three leads connected to the inner leads 32 (see Fig. 6(b)) are formed on one end side in the Y-direction. Further, the outer leads 43 including three leads connected to the inner leads 33 (see Fig. 6(b)) and the outer leads

44 including three leads connected to the inner leads 34 (see Fig. 6(b)) are formed on the other end side in the Y-direction.

At step (a-3), the inner leads 13 are formed along the Y-direction inside the outer leads 14 (see Figs. 3(e) and 3(f) and Figs. 6(a) and 6(b)). At step (a-3), the punches of the die first form punched regions 35 extending in the Y-direction at both end portions in the X-direction. Meanwhile, the punches of the die form punched regions 36 extending in the Y-direction at a center portion in the X-direction (see Fig. 6(a)). Each punched region 35 is formed in such a manner that the substantially entire area between the punched regions 45 at both end portions in the Y-direction is punched. The punched regions 36 are, along the Y-direction, formed at four spots inside each of the punched regions 45 formed at the both end portions in the Y-direction. Four punched regions 36 extend in the Y-direction by the same length (a length shorter than that of the punched region 35). Two of four punched regions 36 are formed on one end side in the Y-direction. The remaining two of the punched regions 36 are formed on the other end side in the Y-direction. Moreover, two punched regions 36 on one end side in the Y-direction are, as in two punched regions 36 on the other end side in the Y-direction, arranged facing each other along the X-direction. Further, on both end sides in the Y-direction, the punched region 35 on one end side in the X-direction, the punched regions 36 closer to the punched region 35 on the one end side in the X-direction, the punched regions 36 closer to the punched regions 35 on the other end side in the X-direction, and the punched region 35 on the other end side in the X-direction are arranged at regular intervals along the X-direction. Subsequently, the punches of the die form a single punched region 37 between adjacent punched regions 35, 36, between adjacent punched regions 36, and between adjacent punched regions 36, 35. The punched region 37 described herein extends in the Y-direction by the same length as that of the punched

region 36. In addition, the die punches form, at the center portion of the lead frame 1, a punched region 95 extending in the Y-direction (see Fig. 6(b)).

In this manner, as illustrated in Fig. 6(b), the inner leads 13 extending in the Y-direction are formed between adjacent punched regions 35, 37, between adjacent punched region 37, 36, between adjacent punched regions 36, 37, between adjacent punched region 37, 36, between adjacent punched regions 36, 37, and between adjacent punched regions 37, 35. More specifically, on one end side in the Y-direction, the inner leads 31 including three leads connected to the outer leads 41 and the inner leads 32 including three leads connected to the outer leads 42 are formed. Further, on the other end side in the Y-direction, the inner leads 33 including three leads connected to the outer leads 43 and the inner leads 34 including three leads connected to the outer leads 44 are formed.

At step (a-4), the tip ends (the side opposite to the side connected to the outer leads 14) of the inner leads 13 are further punched such that the separating regions 210, 220 and regions of the linking portions 90 are defined. That is, at this step, the separating regions 210, 220 and the linking portions 90 are formed (see Figs. 3(g) to 3(i), Figs. 7(a) and 7(b), and Fig. 8). From the separating regions 210, 220, the separate die pads 21, 22 are formed in such a manner that the linking portions 90 are cut at step (C) described later. The linking portions 90 are configured to link the separating regions 210, 220 to each other.

At step (a-4), the punches of the die first form a punched region 51 at the tip ends of the inner leads 31, 32. In addition, the punches of the die form a punched region 52 at the tip ends of the inner leads 33, 34 (see Fig. 7(a)). The punched region 51 is punched in a rectangular shape, for example. The punched region 51 extends along the X-direction between two punched regions 36. Further, the punched region 51 extends, along the Y-direction, from substantially center portions of the punched regions 36

beyond tip ends of the punched regions 36. The punched region 52 is punched in a rectangular shape, for example. The punched region 52 extends along X-direction between the punched regions 37 on both end sides in the X-direction. Further, the punched region 52 extends, along the Y-direction, from substantially center portions of the punched regions 37 beyond tip ends of the punched regions 37. Subsequently, the punches of the die form, along the X-direction, punched regions 53 at the tip ends of outermost ones of the inner leads 31, 32 (see Fig. 7(b)). The punched regions 53 are regions punched in a rectangular shape, for example. Each punched region 53 extends along the X-direction between the punched region 35 and the adjacent punched region 37. Further, the punched regions 53 extend, along the Y-direction, from substantially center portions of the punched regions 37 beyond tip ends of the punched regions 37.

The punched regions 51, 52, 53 are formed as described above. In this manner, as illustrated in Fig. 8, the separating regions 210, 220 and the regions of the linking portions 90 are defined. The separating region 210 is connected only to the middle one of the inner leads 31 in the X-direction and to the outermost one of the inner leads 33 along the X-direction. The separating region 220 is connected only to the middle one of the inner leads 32 in the X-direction and to the outermost one of the inner leads 34 along the X-direction.

Moreover, as illustrated in Fig. 8, the linking portions 90 are formed as portions linking the separating regions 210, 220 to each other. The linking portions 90 include linking portions 91, 92 separated from each other. The linking portions 91, 92 are configured to link the both end portions of the separating regions 210, 220 in the Y-direction. That is, the linking portion 91 links one end portions of the separating regions 210, 220 in the Y-direction. The linking portion 92 links the other end portions of the separating regions 210, 220 in the Y-direction. As described above, at step (a-4), the

linking portions 91, 92 separated from each other are formed. In this state, the linking portions 91, 92 are arranged at the both end portions of the separating regions 210, 220 in the Y-direction.

When steps (a-0) to (a-4) are performed to complete step (A), the band-shaped processing material 80 is processed into the shape of a lead frame including a die pad portion. After step (A) and before depressing of step (B), plating may be performed on, e.g., surfaces of the separating regions 210, 220. For example, the plating is performed in such a manner that a plating solution containing plating of noble metal such as silver, nickel, or palladium is sprayed onto the surfaces of the separating regions 210, 220 from a plating nozzle of a typically-used plating device.

Subsequently, step (B) (see Fig. 2(b)) is performed. At step (B), the processing material 80 (the processing material 80 processed into the shape of a lead frame) subjected to plating after step (A) is intermittently sent in one direction by rollers while depressing is performed by the die. Depressing is performed by, e.g., a die including an upper die equipped with bending punches and a lower die having an opening corresponding to the amount of the bending. That is, at step (B), the upper die equipped with the bending punches is lowered to press down the separating regions 210, 220 included in the die pad. In this manner, the semiconductor element arranged on the separate die pads 21, 22 and the tip ends of the inner leads 13 can be arranged on the same plane.

Subsequently, step (C) (see Fig. 2(c)) is performed. At step (C), the linking portions 90 of the processing material 80 after step (B) are cut. In this manner, the die pad is divided into the separate die pads 21, 22. Specifically, the punches of the die simultaneously punch the linking portions 91, 92 (see Fig. 2(b)) linking both end portions of the separating regions 210, 220 in the Y-direction, and in this manner, cuts the linking portions 91, 92. In this manner, the separate die pads 21, 22 illustrated in Fig. 2(c) are

formed. After step (C), parts of the cut linking portions 91, 92 remain as the protruding portions 16 (see Fig. 1) at the separate die pads 21, 22. The protruding portions 16 include the protruding portions 61 and the protruding portions 62. The protruding portions 61 are arranged at both end portions in the Y-direction at a portion of the separate die pad 21 facing the separate die pad 22. The protruding portions 62 are arranged at both end portions in the Y-direction at a portion of the separate die pad 22 facing the separate die pad 21. By the above-described steps, the lead frame 1 including the die pad 12 divided into the separate die pads 21, 22 is produced.

Next, features and advantageous effects of the method for producing the lead frame 1 and features and advantageous effects of the lead frame 1 will be described.

For example, in the method for producing a lead frame 600 according to a comparative example illustrated in Figs. 9(a) and 9(b), a processing material 580 is processed into a shape of a lead frame including a die pad 512 divided into separate die pads 521, 522 as illustrated in Fig. 9(a). Thereafter, as illustrated in Fig. 9(b), the separate die pads 521, 522 are displaced downward by a predetermined height by depressing. In the depressing of the processing material processed into the shape of a lead frame including the separate die pads, a vertical gap might be formed between the separate die pads 521, 522 by the depressing. For example, in a case where both end portions of the separate die pads 521, 522 are connected to inner leads (suspension leads), torque due to the depressing easily acts on the separate die pads 521, 522 suspended from the inner leads. Such torque is notably great, for example, in a case where the thicknesses of the inner leads connected to the both end portions are different from each other or in a case where the positions of the X-direction (the suspension positions) of the inner leads connected to the both end portions are different from each other. Moreover, the torque difference between the separate die pads 521, 522 might lead to the vertical

gap (a positional shift) between the separate die pads 521, 522, for example.

For solving such a problem, the method for producing the lead frame 1 including the die pad 12 divided into the separate die pads 21, 22 according to the present embodiment includes, in the sequence set forth, the steps of (A) processing the processing material 80 into a shape of a lead frame including a die pad portion, (B) depressing the processing material 80 processed into the shape of a lead frame, and (C) dividing the die pad portion of the processing material 80 to form separate die pads 21, 22.

In the method for producing the lead frame 1 according to the present embodiment, the processing material 80 processed into the shape of a lead frame is depressed. Thereafter, the die pad portion including the die pad 12 is divided. As described above, the die pad portion is divided after the depressing, and therefore, force (e.g., the above-described torque) relating to the depressing is applied to the undivided die pad portion upon depressing. In this production method, the vertical gap (the positional shift), which is the problem in the above-described method for producing the lead frame 600 according to the comparative example, generated between the separate die pads can be reduced. As described above, according to the method for producing the lead frame 1 according to the present embodiment, the vertical gap generated between the separate die pads 521, 522 can be reduced.

At the step of processing the processing material 80 into the shape of a lead frame, the linking portions 90 are formed to link the separating regions 210, 220 corresponding to the separate die pads 21, 22. Then, at the subsequent step, the linking portions 90 are cut to divide the die pad portion including the die pad 12. In this manner, the linking portions 90 formed distinctively from the separating regions 210, 220 are cut to divide the die pad portion. Accordingly, the separate die pads 21, 22 can be reliably formed from the desired regions of the die pad 12.

At the step of processing the processing material 80 into the shape of a lead frame, the linking portions 91, 92 separated from each other are formed. Upon cutting the linking portions 91, 92, the linking portions 91, 92 are, for example, punched while portions of the separating regions 210, 220, the portions corresponding to the linking portions 91, 92 (e.g., the portions continuously connected to the linking portions 91, 92), are held by a stripper etc. At this point, surface processing such as plating is performed on the separating regions 210, 220 before cutting the linking portions 91, 92. Thus, the portions held by the stripper etc. are preferably as small as possible. On this point, the linking portions 91, 92 are provided separately from each other, and therefore, some portions of the separating regions 210, 220 are not corresponding to the linking portions 91, 92. Thus, as compared to, e.g., a case where only one linking portion is provided along a boundary between the separate regions 210, 220, the portions held by the stripper etc. upon cutting the linking portions 91, 92 can be smaller.

At the step of processing the processing material 80 into the shape of a lead frame, the linking portions 91, 92 are arranged at both end portions of the separating regions 210, 220 in the direction (the Y-direction) crossing a direction in which the separating regions 210, 220 face each other. The inner leads 31, 32, 33, 34 are connected to both end portions of the separating regions 210, 220 in the Y-direction. Thus, upon depressing, torque is easily applied to the both end sides. Accordingly, deformation of the separating regions might occur. On this point, the linking portions 91, 92 are provided at the both end portions of the separating regions 210, 220 so that the deformation of the separating regions 210, 220 due to the force applied to the both end sides can be reduced.

As illustrated in Fig. 1, the lead frame 1 of the present embodiment includes the inner leads 31, 32, 33, 34, the separate die pad 21 connected to the inner leads 31, 33, the separate die pad 22 separated from the separate die pad 21 and connected to the inner

leads 32, 34, the protruding portions 61 arranged on the separate die pad 21 and protruding to face the separate die pad 22, and the protruding portions 62 arranged on the separate die pad 22 and protruding to face the separate die pad 21. Due to the protruding portions 61 and the protruding portions 62, the surface areas of side surfaces (opposing surfaces) of the separate die pads 21, 22 can be increased. Thus, resin adhesiveness upon resin sealing at the packaging step can be improved.

The embodiment of the present invention has been described above, but is not limited to the above-described embodiments. For example, the present embodiment is not limited to one of the above-described embodiments in which the linking portions 91, 92 directly link the separating regions 210, 220 included in the die pad portion. For example, the linking portion may be arranged between the inner leads included in the die pad portion. In this case, as illustrated in Fig. 10(a), at the step of processing the processing material 180 into the shape of a lead frame, punching may be performed such that the separating regions are each connected to the inner leads 31, 32 and a linking portion 190 is formed between the inner leads 31, 32. In this state, as illustrated in Fig. 10(b), the separating regions are pressed down by depressing. Finally, as illustrated in Fig. 10(c), the linking portion 190 is cut to form separate die pads 121, 122. In this manner, a lead frame 100 is produced. As in the lead frame 1, the linking portion is cut to form protruding portions 116 in the lead frame 100. That is, as illustrated in Fig. 10(c), the protruding portion 161 protruding to face the inner lead 32 is formed on the inner lead 31 connected to the separate die pad 121. Similarly, the protruding portion 162 protruding to face the inner lead 31 is formed on the inner lead 32 connected to the separate die pad 122.

Moreover, in the above-described embodiment, the protruding portions 61, 62 are, as the remaining portions of the linking portions 90 cut at the step of producing the

lead frame 1, formed on the separate die pads 21, 22. Note that at the step of producing the lead frame, recessed portions 361, 362 may be, for example, each formed at separate die pads 321, 322 when linking portions 365 (hatched portions in Fig. 11) are cut, as illustrated in Fig. 11. That is, a shape formed by cutting the linking portions may be a protruding shape as illustrated in Fig. 1. Alternatively, this shape may be a recessed shape as in the recessed portions 361, 362 of Fig. 11. Note that as illustrated in Fig. 11, punches 369 for forming the recessed portions 361, 362 are configured to punch regions including the periphery of the linking portions 365. The depths of the recessed portions 361, 362 are not specifically limited. A preferable depth is 50 μm to 100 μm. In this case, the surface areas of side surfaces (opposing surfaces) of the separate die pads 321, 322 are increased so that the resin adhesiveness upon resin sealing at the packaging step can be improved.

For Publication

METHOD FOR PRODUCING LEAD FRAME AND LEAD FRAME

BACKGROUND

1. Technical Field

The present disclosure relates to a method for producing a lead frame and the lead frame.

2. Description of the Related Art

In a semiconductor package, a lead frame is used for the connection between a semiconductor element and the external wiring. A lead frame including separate die pads is known. The separate die pads are formed through dividing a die pad configured to support and hold a semiconductor element (see, e.g., JP-A-2000-22036).

SUMMARY

At the step of producing the lead frame, depressing is performed in some cases. In depressing, the die pad is displaced downward by a predetermined height such that the semiconductor element mounted on the die pad and inner lead tip ends are positioned on the same plane. Thus, a vertical gap might be generated between the separate die pads by the depressing of the lead frame including the separate die pads.

For this reason, the present disclosure describes a method for producing a lead frame, by which the vertical gap generated between the separate die pads can be reduced, and the produced lead frame.

A method for producing a lead frame according to one embodiment of the present disclosure comprising, in the sequence set forth, the steps of: (A) processing a processing material into a shape of a lead frame including a die pad portion; (B) depressing the processing material; and (C) dividing the die pad portion to form separate die pads.

A lead frame according to one embodiment of the present disclosure comprising: first and second inner leads; a first die pad connected to the first inner lead; a second die pad separated from the first die pad and connected to the second inner lead; a first protruding portion arranged on the first die pad and protruding in a direction of facing the second die pad; and a second protruding portion arranged on the second die pad and protruding in a direction of facing the first die pad.

According to the method for producing a lead frame and the lead frame of the present disclosure, the vertical gap generated between the separate die pads can be suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of one example of a lead frame;

Figs. 2(a) to 2(c) are plan views describing the step of producing the lead frame, Fig. 2(a) is a plan view describing a lead frame shape formation step, Fig. 2(b) is a plan view describing depressing step, and Fig. 2(c) is a plan view describing a linking portion cutting step;

Figs. 3(a) to 3(i) are plan views of an entire layout in punching of the lead frame shape formation step;

Figs. 4(a) and 4(b) are enlarged plan views of Figs. 3(a) and 3(b) of the layout illustrated in Figs. 3(a) to 3(i);

Figs. 5(a) and 5(b) are enlarged plan views of Figs. 3(c) and 3(d) of the layout illustrated in Figs. 3(a) to 3(i);

Figs. 6(a) and 6(b) are enlarged plan views of Figs. 3(e) and 3(f) of the layout illustrated in Figs. 3(a) to 3(i);

Figs. 7(a) and 7(b) are enlarged plan views of Figs. 3(g) and 3(h) of the layout

illustrated in Figs. 3(a) to 3(i);

Fig. 8 is an enlarged plan view of Fig. 3I of the layout illustrated in Figs. 3(a) to 3I;

Figs. 9(a) and 9(b) are plan views describing the step of producing a lead frame according to a comparative example, Fig. 9(a) is a plan view describing a lead frame shape molding step and Fig. 9(b) is a plan view illustrating a depressing step;

Fig. 10 is a plan view of one example of a lead frame according to a variation; and

Fig. 11 is a plan view of one example of a lead frame according to another variation.

DESCRIPTION OF THE EMBODIMENTS

An embodiment according to the present disclosure as described below is an example for describing the present invention. The present invention is not limited to the following contents.

<Outline of Embodiment>

[1] The method for producing a lead frame according to one embodiment of the present disclosure, includes, in the sequence set forth, the steps of (A) processing a processing material into a shape of a lead frame including a die pad portion, (B) depressing the processing material, and (C) dividing the die pad portion to form separate die pads.

In the above-described lead frame production method, the processing material is processed into the shape of a lead frame including the die pad portion. Subsequently, the processing material is depressed. Thereafter, the die pad portion is divided to form

the separate die pads. The die pad portion described herein includes at least a die pad and an inner lead connected to the die pad. Moreover, a later-described linking portion is also included in the die pad portion. In the case of performing depressing on the lead frame including the divided die pad portion, a vertical gap (a positional shift) might be generated between the separate die pads. On this point, in the case of the production method, in which the die pad portion is divided after depressing as in the present embodiment, the die pad portion is not divided upon depressing. Thus, the vertical gap (the positional shift) between the separate die pads due to depressing can be reduced.

[2] In the production method [1], step (A) may include forming a linking portion configured to link separating regions corresponding to the separate die pads. In this case, step (C) includes cutting the linking portion. As described above, the die pad portion is divided by cutting the linking portion formed distinctively from the separating region so that the separate die pads can be reliably formed in the desired regions of the die pad.

[3] In the production method [2], step (A) may include forming linking portions separated from each other. Upon cutting the linking portions, the linking portions are punched through while portions of the separating regions, the portions corresponding to the linking portions (e.g., the portions continuously connected to the linking portions), are held by a stripper etc. At this point, surface processing such as plating is performed on the separating regions before cutting the linking portions. Thus, the portions held by the stripper etc. are preferably as small as possible. On this point, the linking portions are provided separately from each other, and therefore, some portions of the separating regions are not corresponding to the linking portions. Thus, as compared to, e.g., a case where only one linking portion is provided along a boundary between the separating regions, the portions held by the stripper etc. upon cutting the linking portions can be smaller.

[4] In the production method [2] or [3], step (A) may include forming the linking portions at both end portions of each separating region in a direction crossing a direction in which the separating regions face each other. Inner leads etc. are connected to the both end portions (the both end portions in the direction crossing the direction in which the separating regions face each other) of the separating regions. Thus, upon depressing, torque that displaces the separating regions from their proper positions is easily applied to the both end sides. Accordingly, deformation of the separating regions might occur. On this point, the linking portions are provided at the both end portions of the separating regions so that the deformation of the separating regions due to the force applied to the both end sides can be reduced.

[5] In the production method [1], step (A) may include forming separating regions corresponding to the separate die pads such that the separating regions are each connected to different inner leads, and forming a linking portion between the different inner leads. In this case, at step (C), the linking portion is cut to divide the die pad portion, too. The linking portion is provided between the inner leads, and therefore, the portions of the separating regions held by the stripper upon cutting the linking portion can be smaller.

[6] A lead frame according to one embodiment of the present disclosure includes first and second inner leads, a first die pad connected to the first inner lead, a second die pad separated from the first die pad and connected to the second inner lead, a first protruding portion arranged on the first die pad and protruding in the direction of facing the second die pad, and a second protruding portion arranged on the second die pad and protruding in the direction of facing the first die pad. By the above-described production method, the die pad is divided after depressing, and the lead frame can be obtained. This lead frame includes, as the remaining portions of the cut linking portions, the portions

(the first protruding portion and the second protruding portion) each protruding toward the opposing die pads between the separate die pads (the first die pad and the second die pad). In this lead frame, the deformation of the die pad is reduced at the production step (specifically, depressing). Thus, the vertical gap generated between the separate die pads can be reduced. Moreover, the first protruding portion and the second protruding portion are provided so that the surface areas of side surfaces (surfaces opposite to another die pad) of the separate die pads can be increased. Thus, resin adhesiveness upon resin sealing at a packaging step after step (C) can be improved.

<Exemplary Embodiment>

Hereinafter, one exemplary embodiment according to the present disclosure will be described in detail with reference to the drawings. In description below, the same reference numerals are used to represent the same elements or elements with the same functions. The repetitive description of these elements will be omitted.

[Lead Frame]

First, a configuration of a lead frame 1 will be described with reference to Fig. 1. The lead frame 1 is a component included in an integrated circuit such as an integrated circuit (IC) or a large-scale integrated circuit (LSI) or a semiconductor package having a semiconductor element such as a discrete semiconductor, a photo-coupler, or a light emitting diode (LED). The lead frame 1 holds the semiconductor element in the integrated circuit and the semiconductor package, and connects the semiconductor element and the external wiring to each other. For example, the lead frame 1 is formed by punching (pressing) or etching of a metal thin plate (a processing material) of a copper alloy-based material or an iron alloy-based material. In description below, an example where the lead frame 1 is formed by punching will be described.

As illustrated in Fig. 1, the lead frame 1 is in a substantially rectangular shape as

viewed in plane. The lead frame 1 includes a die pad 12, inner leads 13, outer leads 14, slits 15, and protruding portions 16. In description below, a lateral direction of the lead frame 1 as viewed in plane will be sometimes referred to as an "X-direction," and a longitudinal direction of the lead frame 1 as viewed in plane will be sometimes referred to as a "Y-direction."

The die pad 12 arranged at a center portion of the lead frame 1 supports and holds the semiconductor element (an IC chip). The semiconductor element is supported and held onto the die pad 12 in such a manner that the semiconductor element is mounted on an adhesive (a die bond material) applied onto the die pad 12. For example, Ag paste obtained by mixing Ag powder with epoxy-based resin is used as the die bond material. The die pad 12 divided into two die pads at a center position in the X-direction has separate die pads 21, 22. That is, the separate die pads 21, 22 are formed in parallel with each other at a predetermined interval along the X-direction. The separate die pad 21 (a first die pad) is, at both end portions in the Y-direction, connected to later-described inner leads 31, 33 (first inner leads). The separate die pad 22 (a second die pad) is, at both end portions in the Y-direction, connected to later-described inner leads 32, 34 (second inner leads).

The inner leads 13 arranged at the periphery of the die pad 12 connect the semiconductor element on the die pad 12 and the external wiring to each other. The inner leads 13 include the inner leads 31 (the first inner leads) facing one end side of the separate die pad 21 in the Y-direction, the inner leads 32 (the second inner leads) facing one end side of the separate die pad 22, the inner leads 33 (the first inner leads) facing the other end side of the separate die pad 21, and the inner leads 34 (the second inner leads) facing the other end side of the separate die pad 22.

The inner leads 31, 32, 33, 34 are arranged in parallel in the X-direction, and

CLAIMS

1. A method for producing a lead frame, comprising, in the sequence set forth, the steps of:

(A) processing a processing material into a shape of a lead frame including a die pad portion;

(B) depressing the processing material; and

(C) dividing the die pad portion to form separate die pads.

2. The method for producing the lead frame according to claim 1, wherein

step (A) includes forming a linking portion configured to link separating regions corresponding to the separate die pads, and

step (C) includes cutting the linking portion.

3. The method for producing the lead frame according to claim 2, wherein

step (A) includes forming two or more of the linking portions separated from each other.

4. The method for producing the lead frame according to claim 2 or 3, wherein

step (A) includes forming the linking portions at both end portions of each separating region in a direction crossing a direction in which the separating regions face each other.

5. The method for producing the lead frame according to claim 1, wherein

step (A) includes forming separating regions corresponding to the separate die pads such that the separating regions are each connected to different inner leads, and

forming a linking portion between the different inner leads, and

step (C) includes cutting the linking portion.

6. A lead frame comprising:

first and second inner leads;

a first die pad connected to the first inner lead;

a second die pad separated from the first die pad and connected to the second inner lead;

a first protruding portion arranged on the first die pad and protruding in a direction of facing the second die pad; and

a second protruding portion arranged on the second die pad and protruding in a direction of facing the first die pad.

FIG. 1

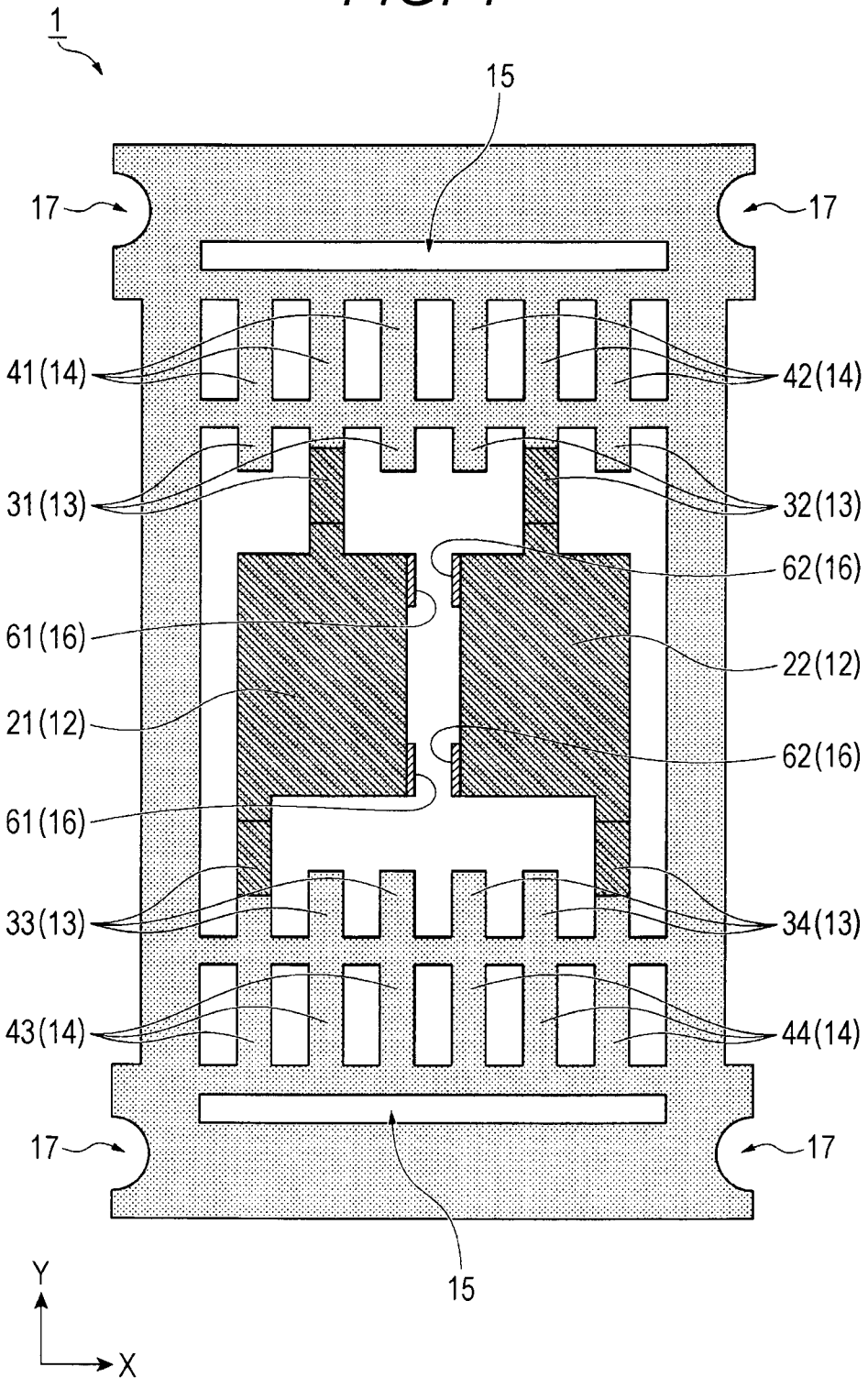

FIG. 2

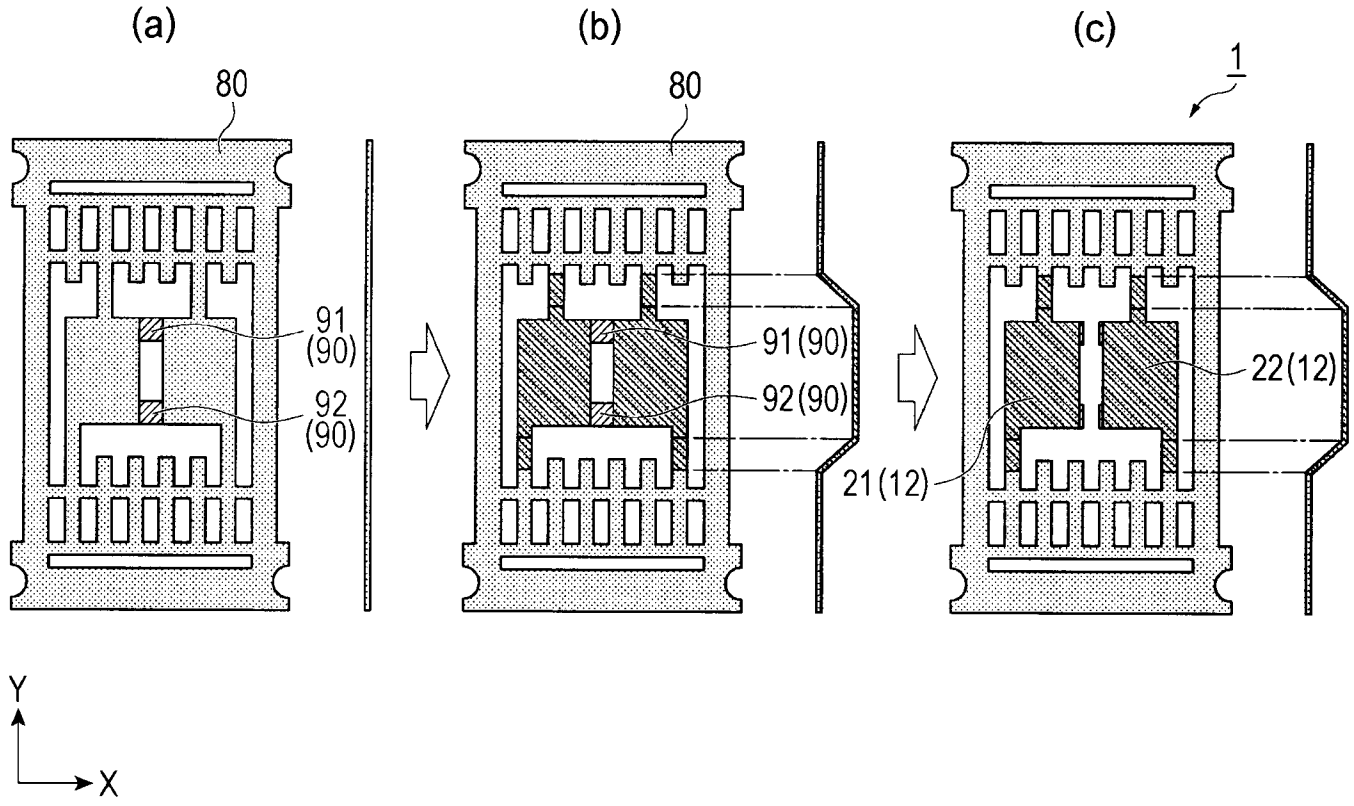

FIG. 3

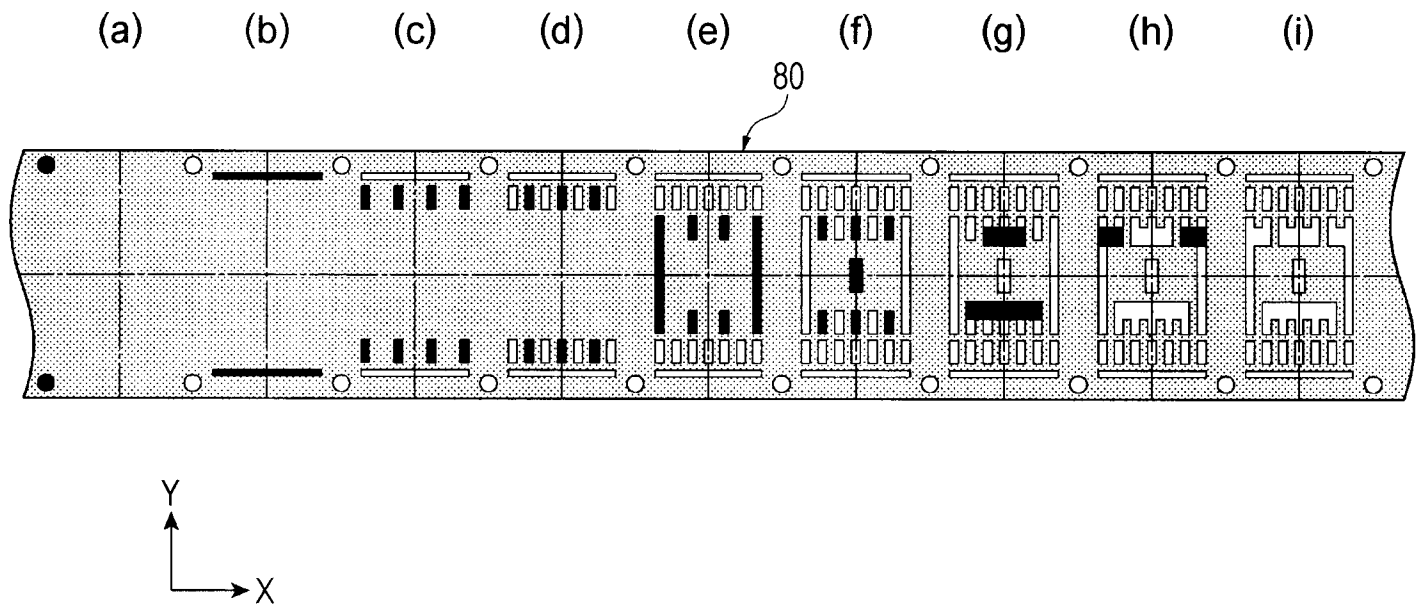

FIG. 4

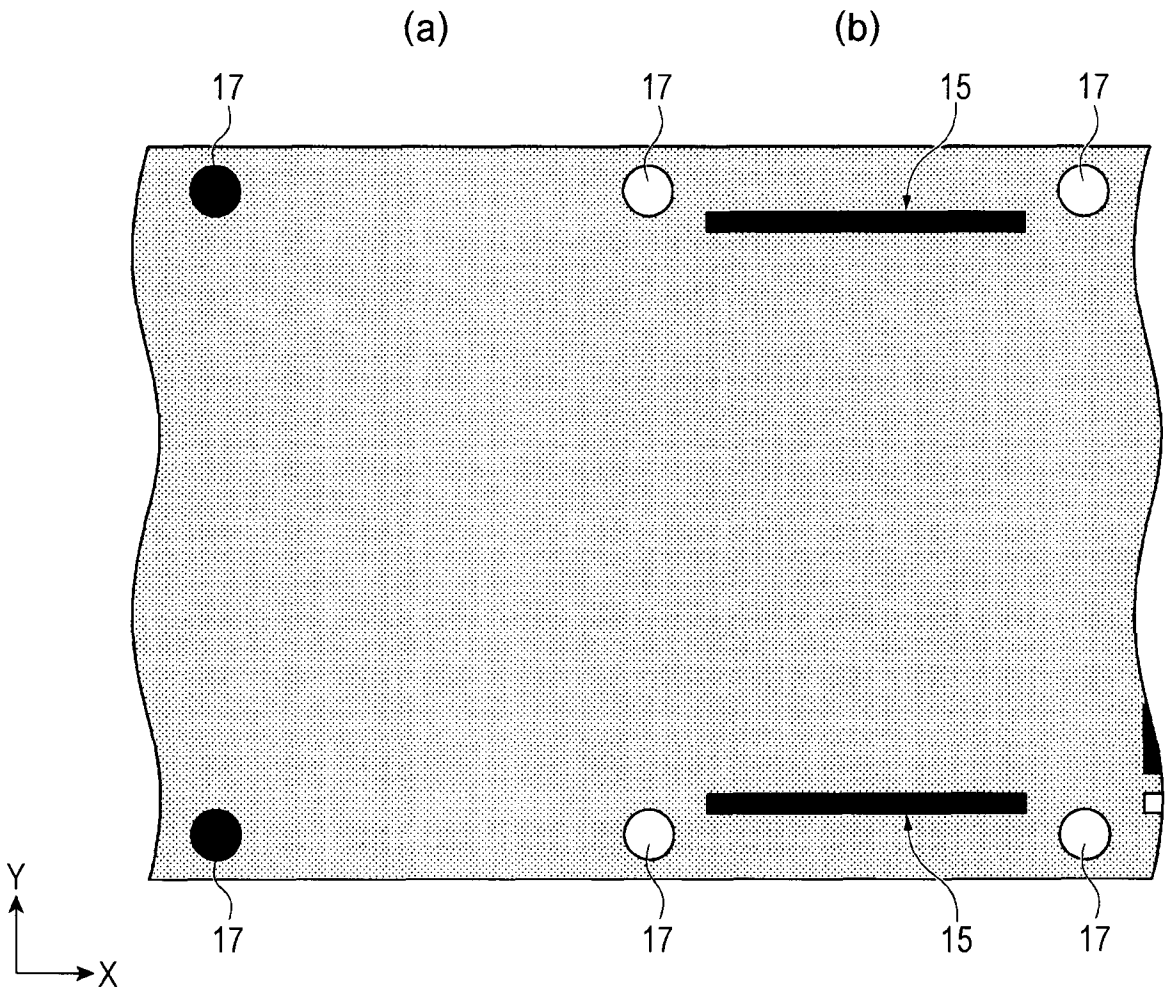

FIG. 5

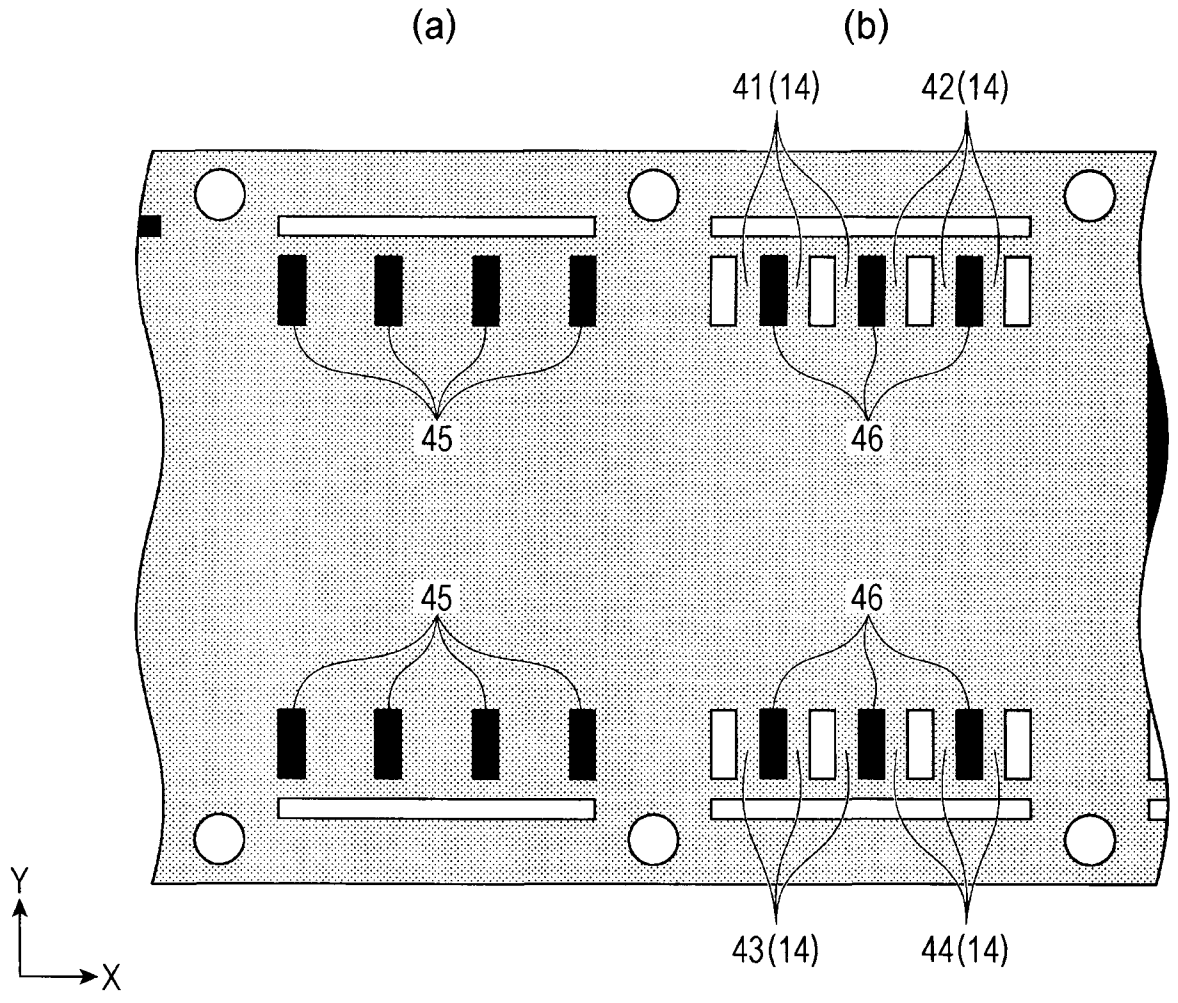

FIG. 6

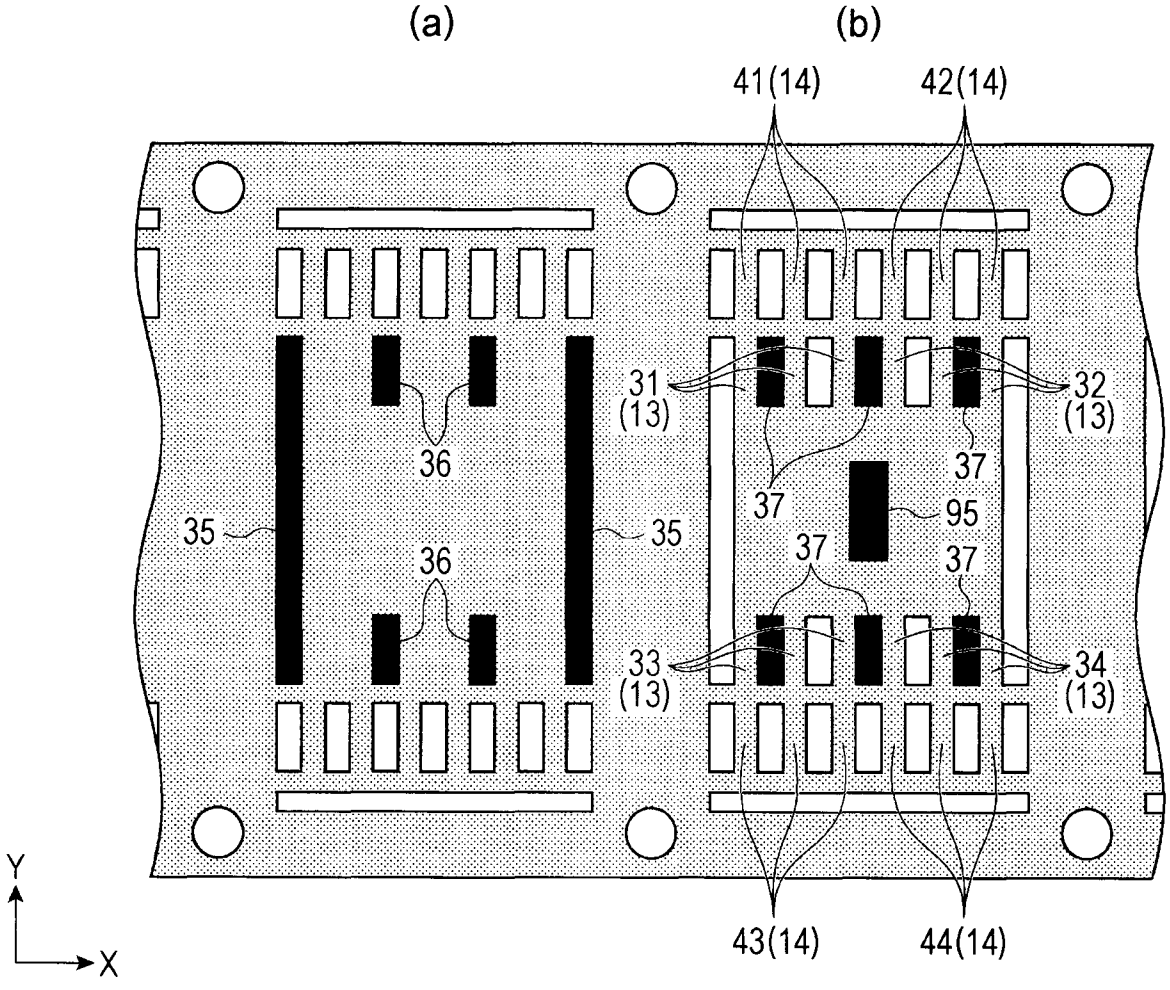

FIG. 7

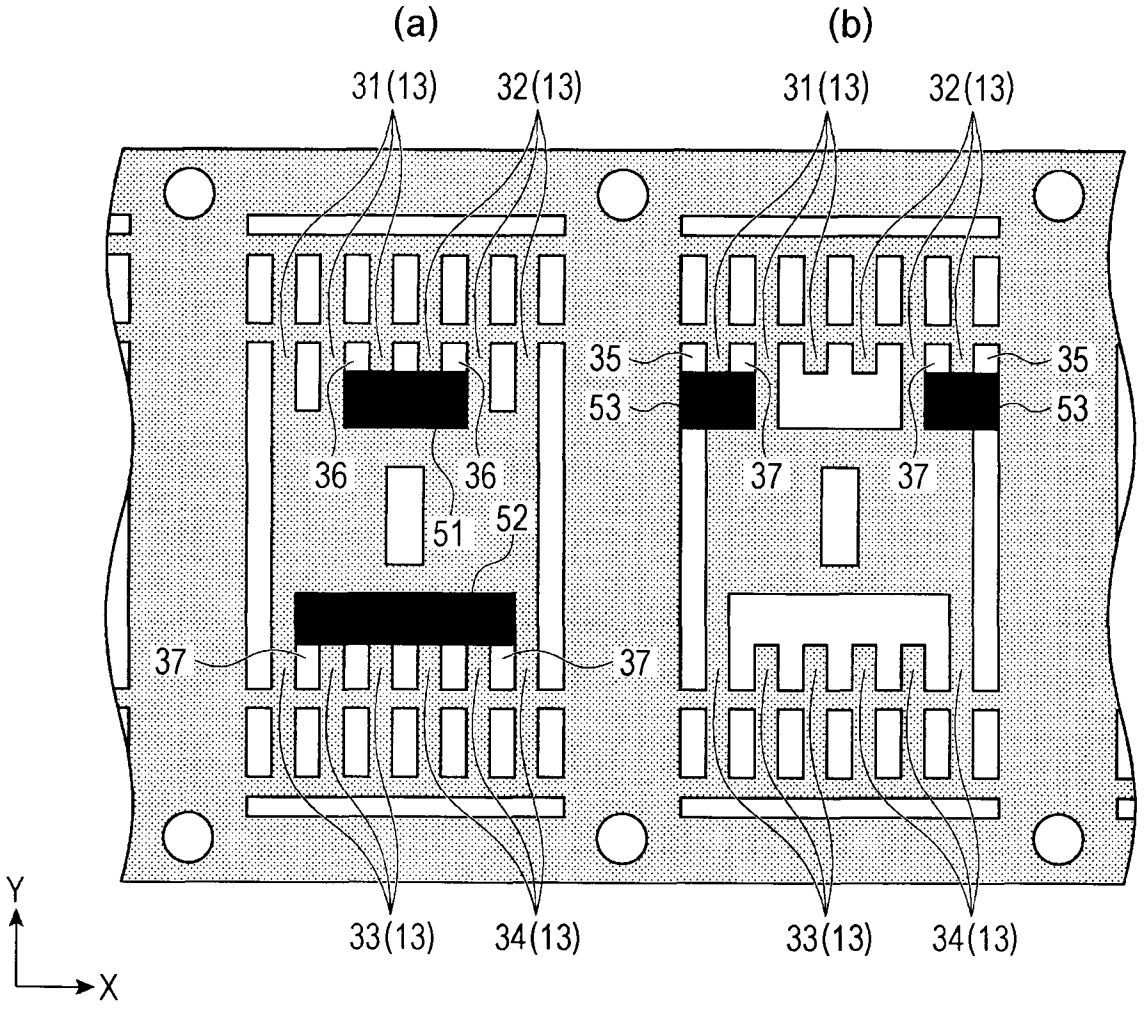

FIG. 8

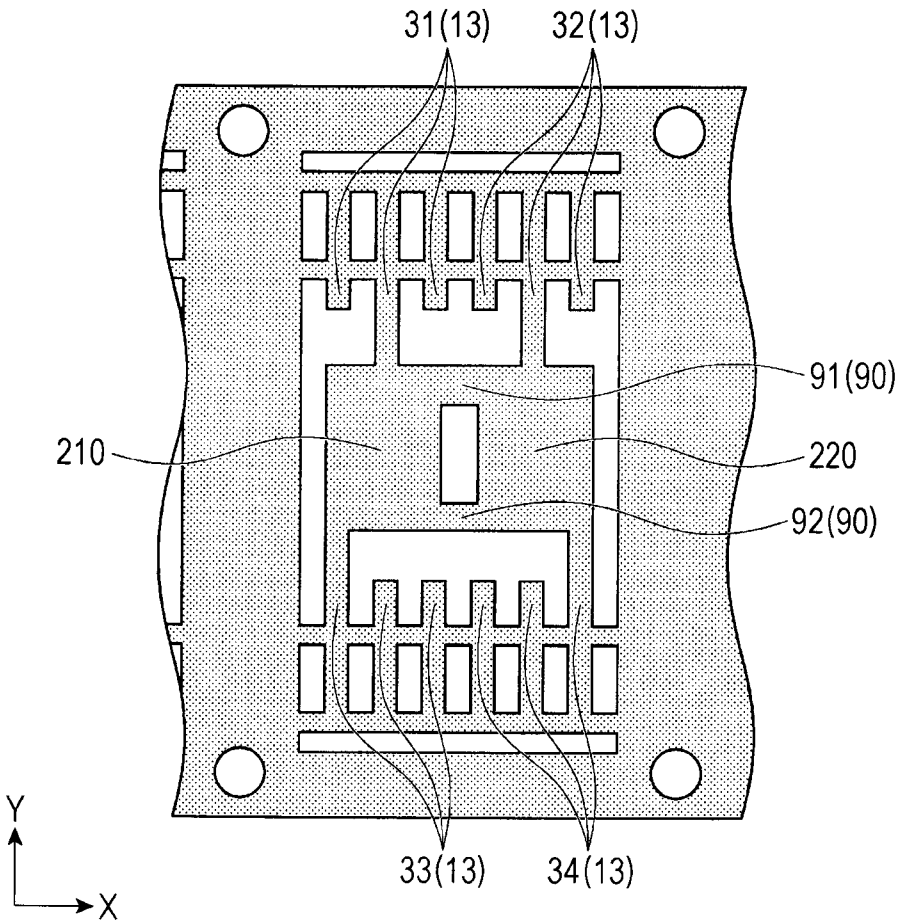

FIG. 9

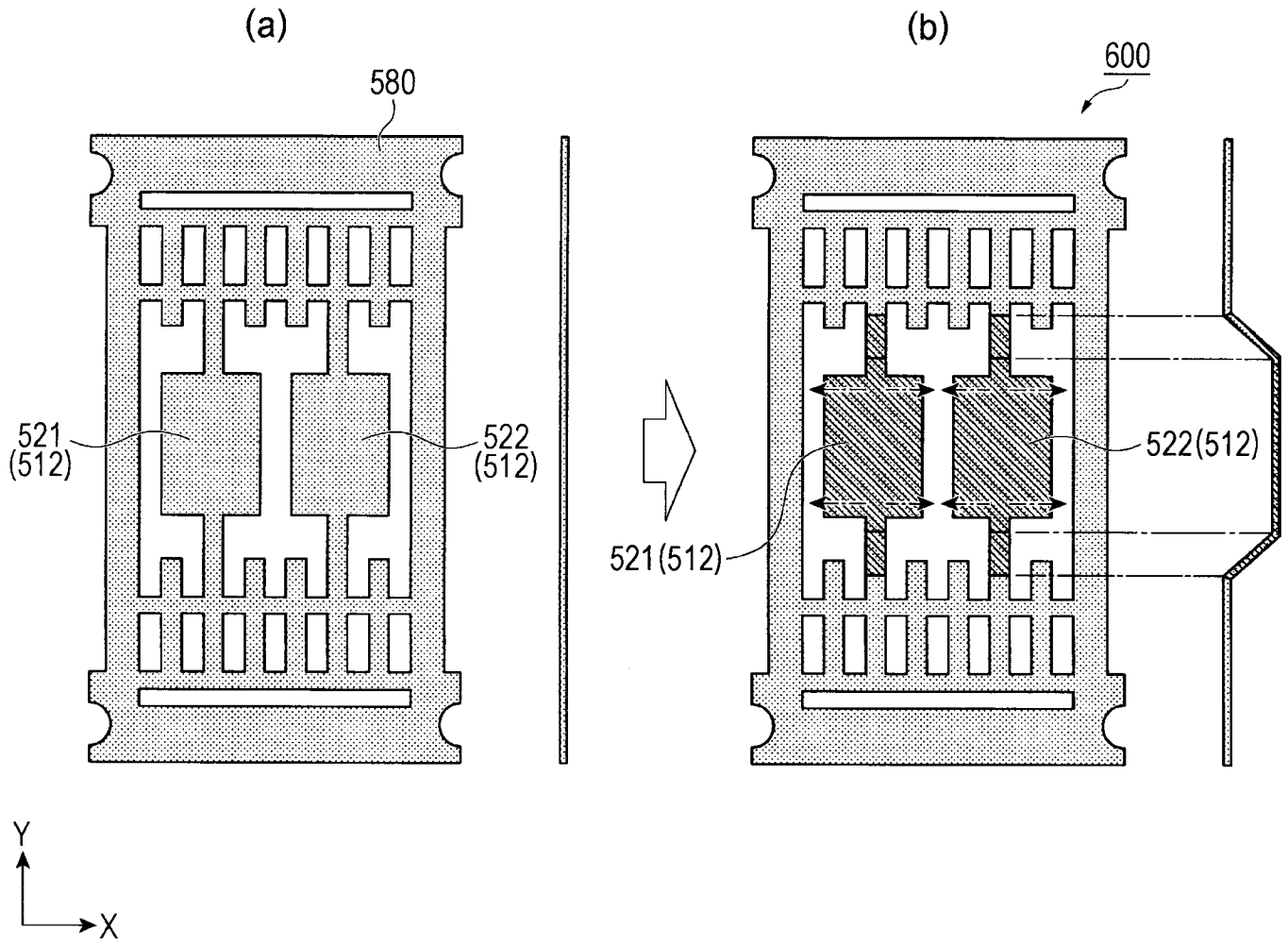

FIG. 10

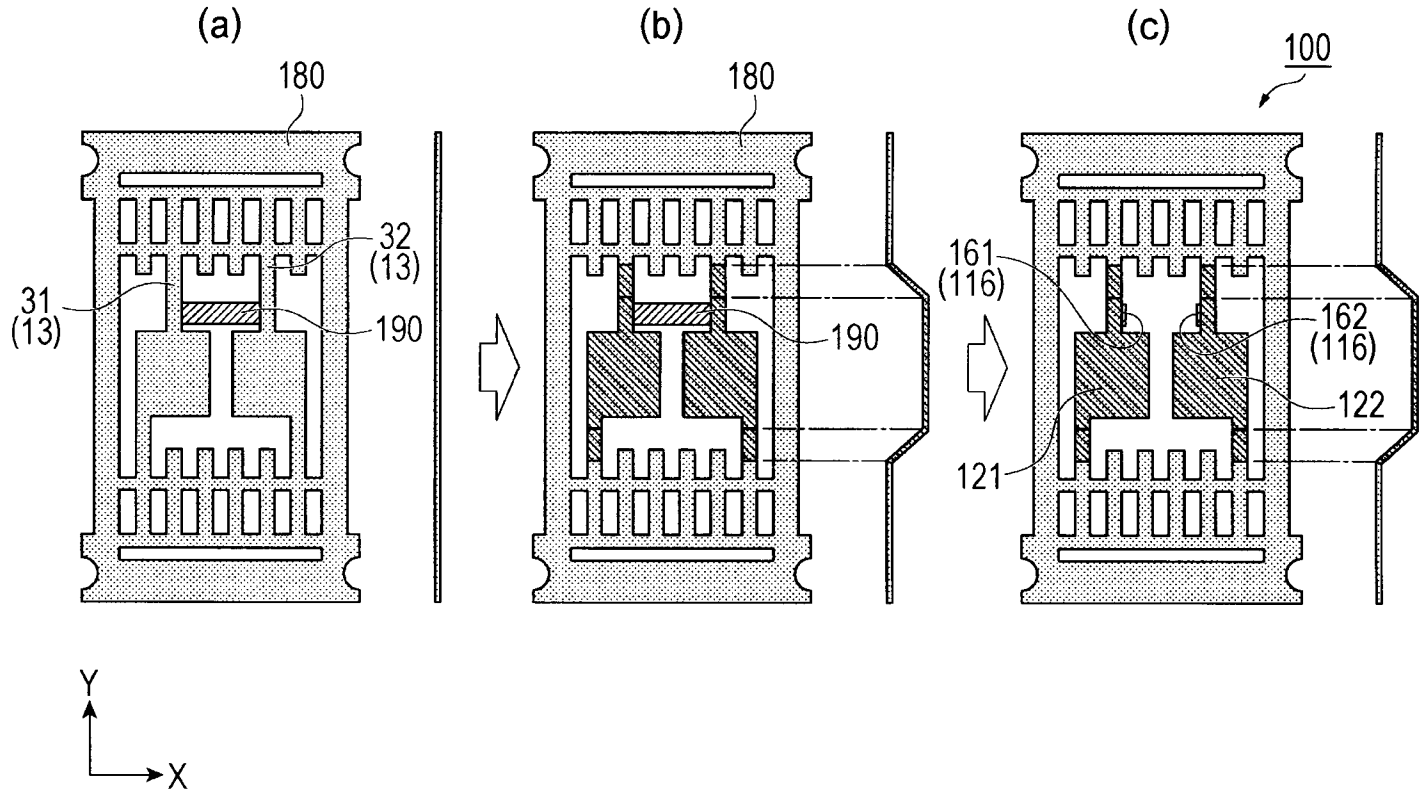

FIG. 11