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(54) **SECURING LIDS TO SEMICONDUCTOR PACKAGES**

(76) Inventors: **Kyle W. Kippes**, Chandler, AZ (US); **Nitin A. Deshpande**, Chandler, AZ (US); **Bruno Clark**, Chandler, AZ (US)

Correspondence Address:
TROP PRUNER & HU, PC
8554 KATY FREEWAY
SUITE 100
HOUSTON, TX 77024 (US)

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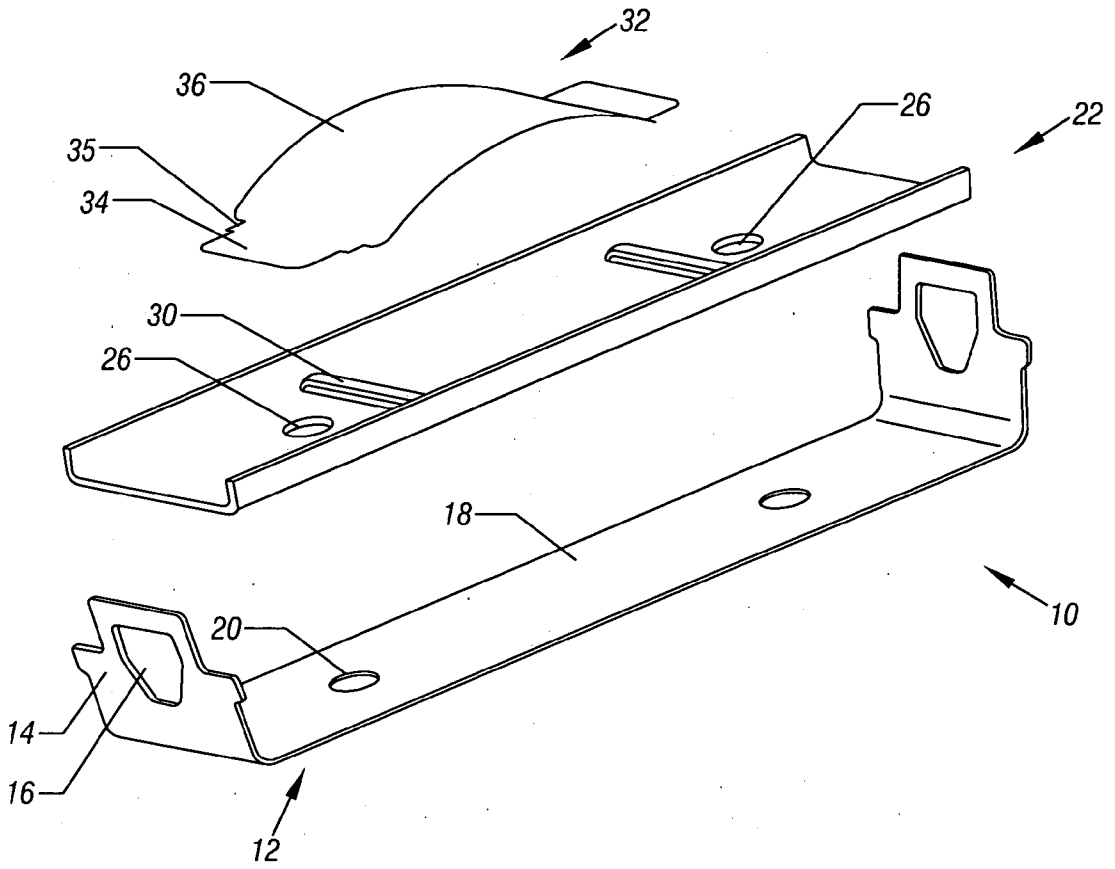
(57) **ABSTRACT**

A bridge clip can provide off center loading between a lid and a semiconductor package during curing of adhesive for attachment of the lid to the integrated circuit die. This may be done, in some embodiments, without requiring an inventory of different parts and a variety of different assembly techniques by providing a leaf spring on the bridge clip which may be adapted for off center loading. The leaf spring may have its apex or centroid displaced with respect to the length of the bridge clip, transversely thereto or some combination thereof as needed. Thus, in some embodiments, a different leaf spring is all that needs to be provided to implement off center loading.



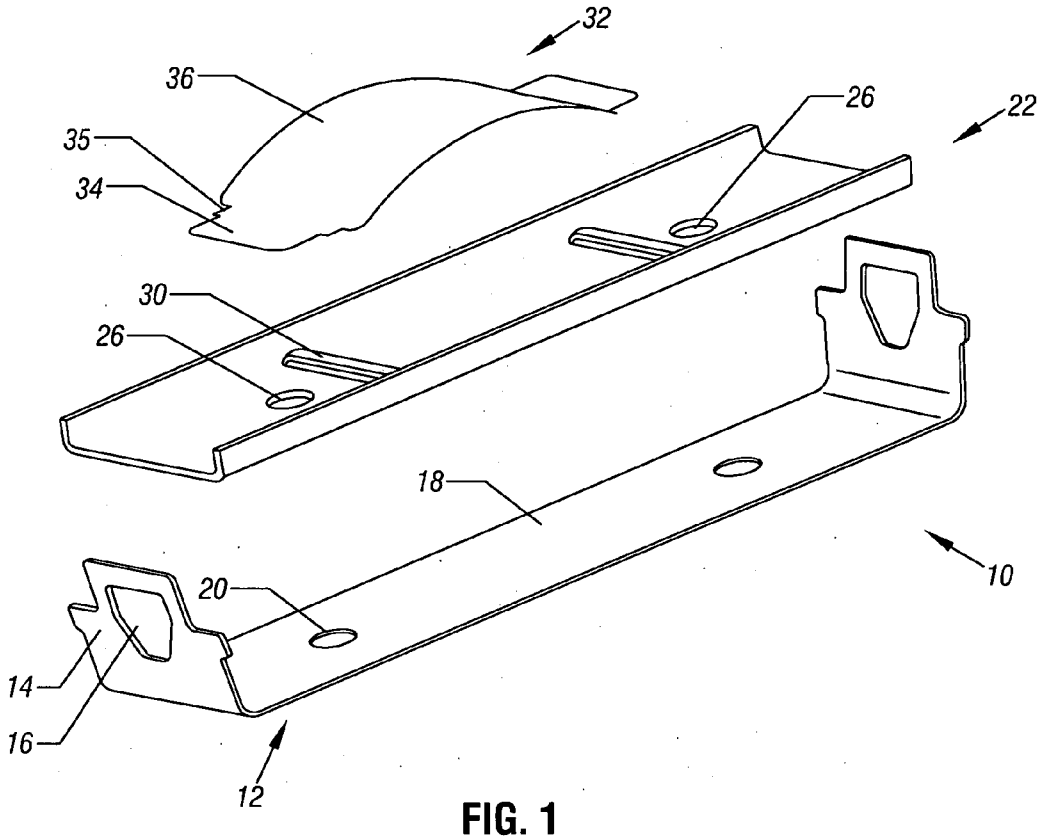


FIG. 1

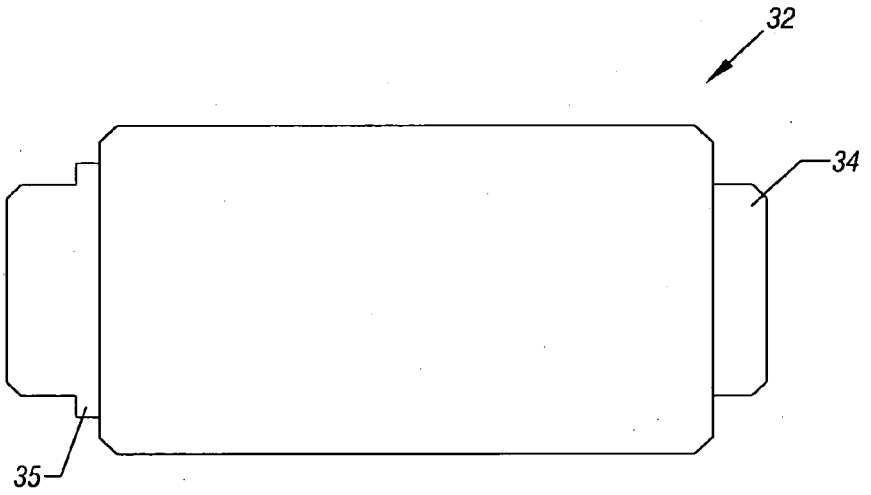


FIG. 2

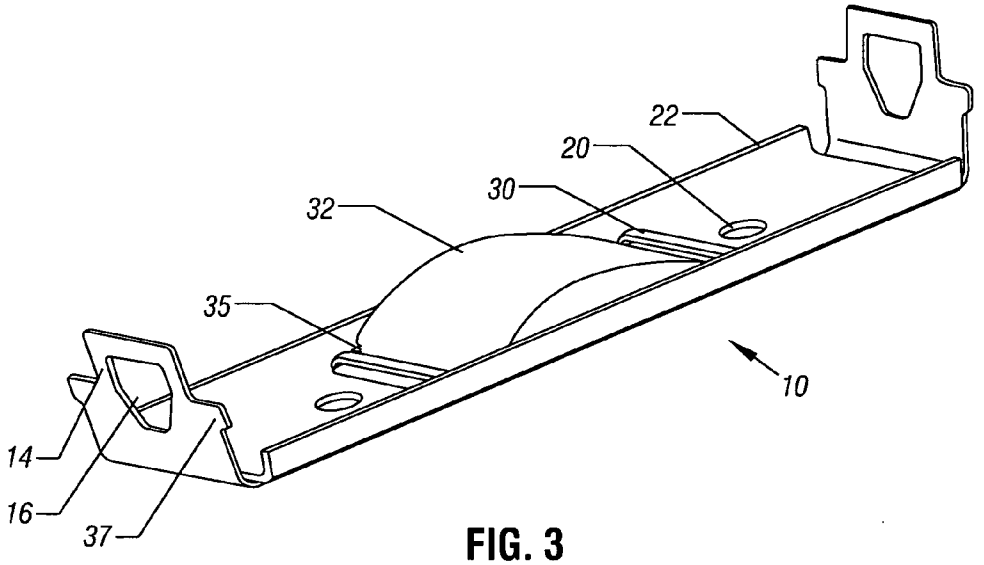

22
20
30
32
35
10
14
16
37

FIG. 3

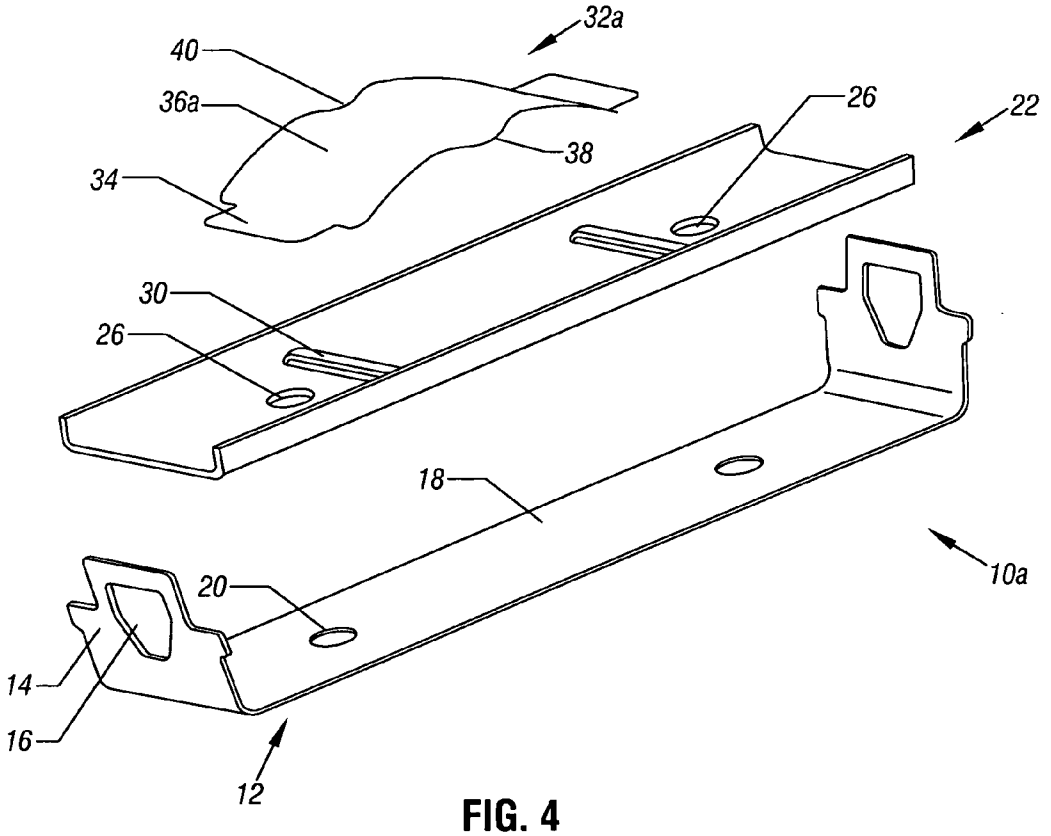

32a
40
36a
34
38
26
22
30
26
18
10a
20
14
16
12

FIG. 4

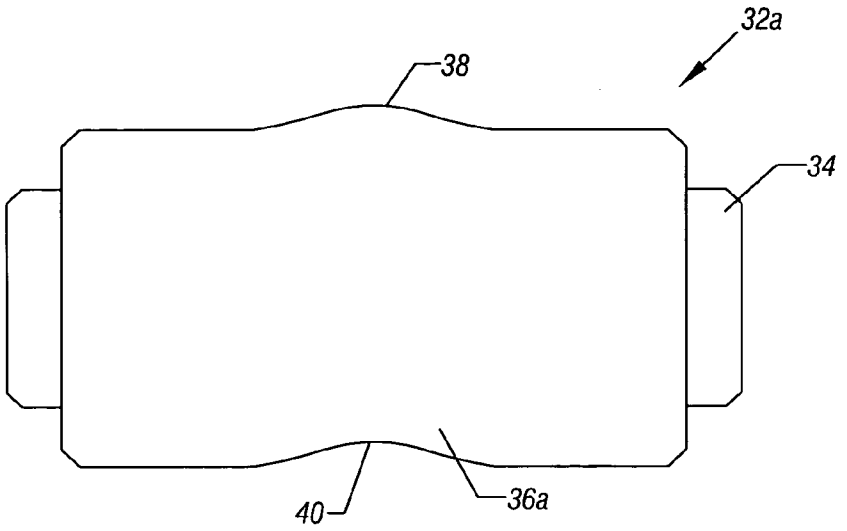


FIG. 5

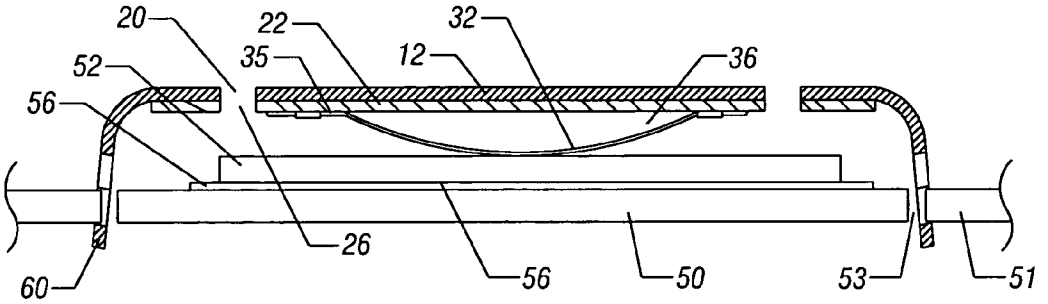


FIG. 7

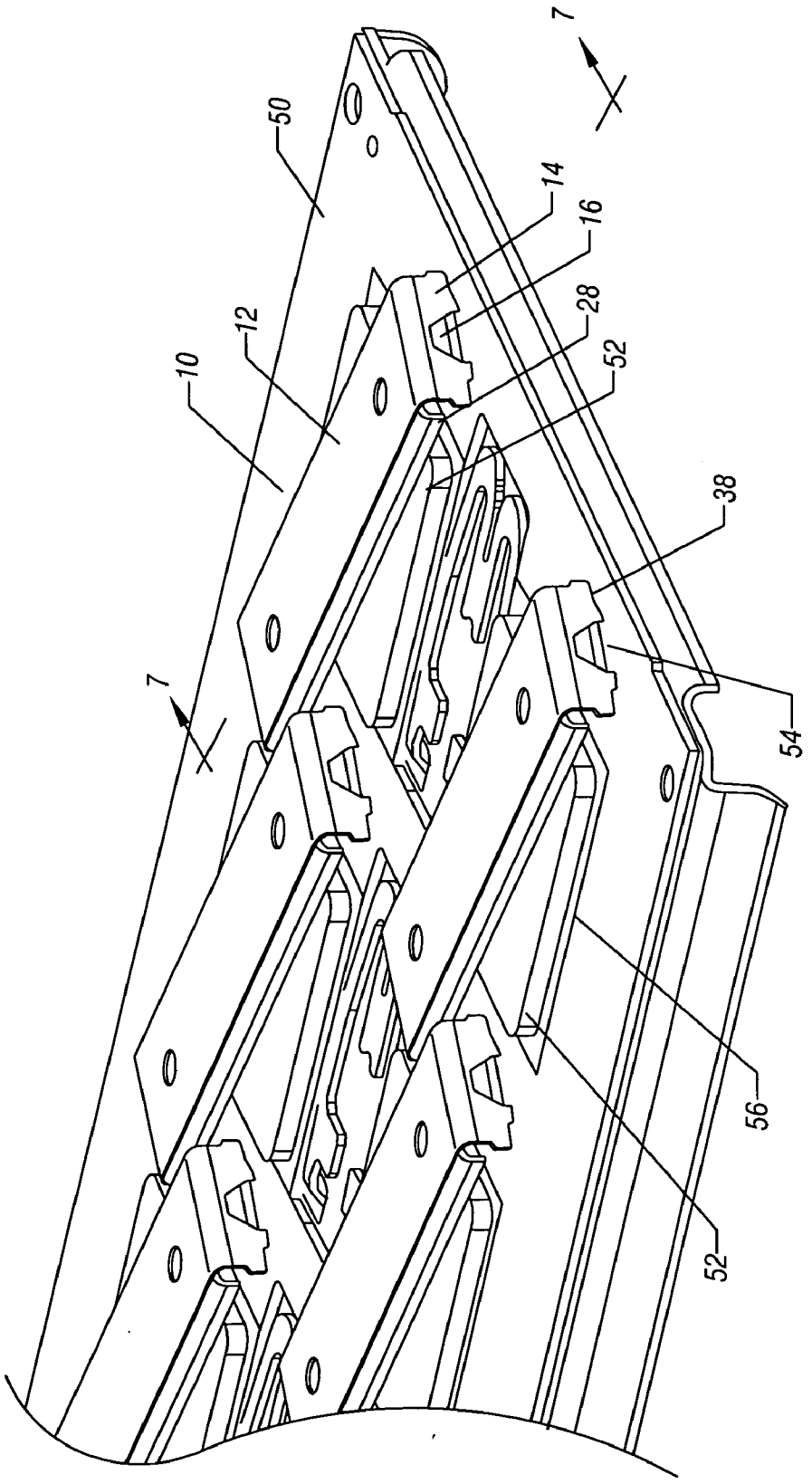


FIG. 6

SECURING LIDS TO SEMICONDUCTOR PACKAGES

BACKGROUND

[0001] This invention relates generally to the assembly of integrated circuit packages.

[0002] In the assembly of integrated circuit packages, an integrated circuit chip or die may be secured to a lid. This attachment may involve providing an epoxy adhesive and thermal grease between the integrated circuit package and the lid. The lid allows thermal communication between the integrated circuit package and an integral heat spreader, which takes heat away from the integrated circuit.

[0003] It is known that the amount of force that is applied between the lid and the package during the curing of the adhesive is critical to the ability of the lid to transfer heat from the package to the integral heat spreader and, ultimately, to heat dissipation devices such as heat sinks. To this end, bridge clips may be utilized to apply a force to the lid against the integrated circuit die during adhesive curing. Generally the bridge clip includes a U-shaped or T-shaped member, a U-shaped stiffener, and a leaf spring. The bridge clip clips onto a metal processing carrier such that the leaf spring is compressed between the stiffener and the lid, providing a downward compressive force to the lid, pushing the lid against the integrated circuit die.

[0004] Conventionally, the stiffener includes louvers which secure the leaf spring in a central location on the bridge clip. Thus, conventionally, an even and distributed load is applied during the lid attachment process because the bridge clip clips into slots in the metal processing carrier, the louvers in the stiffener are centrally located with respect to the stiffener and the bridge and the leaf spring is symmetrical.

[0005] However, in some cases, off center dice may be loaded on the metal processing carrier. These dice may be positioned with respect to the slots in the metal processing carrier in a way in which conventional bridge clips provide an uneven force. This problem may be handled by providing differently sized bridge clips. As a result, the inventory of bridge clips, metal carriers, and handling media for handling metal carriers and bridge clips is greatly increased. This increases the cost of the assembly process.

[0006] Thus, there is a need for a system which handles dice whose centers may be shifted on metal processing carriers without requiring excessive inventories of handling media, metal carriers, and bridge clips.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] **FIG. 1** is an enlarged, exploded perspective view of one embodiment of the present invention;

[0008] **FIG. 2** is an enlarged, top plan view of the leaf spring shown in **FIG. 1** in accordance with one embodiment of the present invention;

[0009] **FIG. 3** is an enlarged, perspective view of the embodiment shown in **FIG. 1** in an assembled condition in accordance with one embodiment of the present invention;

[0010] **FIG. 4** is an enlarged, exploded perspective view of another embodiment of the present invention;

[0011] **FIG. 5** is a top plan view of the leaf spring of the embodiment shown in **FIG. 4** in accordance with one embodiment of the present invention;

[0012] **FIG. 6** is an enlarged, partial view of a metal processing carrier with bridge clips assembled thereon in accordance with one embodiment of the present invention; and

[0013] **FIG. 7** is an enlarged, cross-sectional view taken generally along the line **7-7** in **FIG. 6**.

DETAILED DESCRIPTION

[0014] Referring to **FIG. 1**, a bridge clip **10** includes a bridge **12** having a pair of spaced handling openings **20**. The bridge **12** also includes a pair of end pieces **14** coupled transversely to the member **18** to form the overall U-shape of the bridge **12** in accordance with one embodiment of the present invention. The end pieces **14** include slots **16** engageable by a prong (not shown in **FIG. 1**) of a metal processing carrier (also not shown in **FIG. 1**).

[0015] A U-shaped stiffener **22** may be provided over the bridge **12** in accordance with one embodiment of the present invention. The stiffener **22** may include openings **26** which align with the openings **20** in the bridge **12**. In addition, the stiffener **22** may have inwardly facing, opposed louvers **30** which retain the leaf spring **32** on the stiffener **22** within the bridge clip **10**. In one embodiment of the present invention, the louvers **30** may be symmetrically positioned on the stiffener **22** which is symmetrically positioned on the bridge **12**.

[0016] Asymmetry may be provided in the length direction of the bridge clip **12** by the use of an offset leaf spring **32**. The leaf spring **32** has a curved section **36** and a pair of opposed flanges **34**. The flanges **34** enable the leaf spring **32** to be retained by the louvers **30** on the stiffener **22**. Off center loading is achieved because of the extension **35** of one flange **34** as shown in **FIG. 2**. The extension **35** serves as a flat portion of the leaf spring, reducing the extent of the curved portion **36** and moving its center along the length of the bridge clip **12**. As a result, the bridge clip **12** may be used for off center loading of lids to dice in metal processing carriers which are otherwise unchanged. In other words, by simply changing the leaf spring **32**, off center loading may be implemented without otherwise changing the bridge clip **10** or the metal processing carrier.

[0017] As shown in **FIG. 3**, the leaf spring **32** is centrally loaded into the symmetrically arranged louvers **30** of the stiffener **22**, which is then held on the bridge **12**. The end pieces **14** may have prongs **37** which control the position and extent of engagement between the bridge clip **10** and the metal processing carrier (not shown in **FIG. 3**). The various apertures **26** and **20** may be used by automated equipment to place the bridge clip **10** on the metal processing carrier over a lid and integrated circuit die.

[0018] While the embodiment shown in **FIGS. 1-3** allows off center loading shifted in a direction along the length direction of the bridge clip **10** with respect to its centroid, it may also be desirable to provide off center loading in a direction transverse to the length of the bridge clip. The embodiment shown in **FIGS. 4-7** permits such off center loading.

[0019] The structure shown in **FIG. 4** is identical to that shown in **FIG. 1** except that the leaf spring **32** is replaced with a leaf spring **32***a*. The leaf spring **32***a* does not include the offset portion **35**. Instead, it includes an indented section **40** at the peak of the curved portion **36***a* and an opposing protruding portion **38** at that same peak. As a result, the peak at which the force is applied by the leaf spring **32***a* has its centroid shifted towards the viewer in **FIG. 4**, providing offset loading in a direction transverse to the length of the bridge clip **10***a*.

[0020] This is better shown in **FIG. 5** where it can be seen that the flanges **34** are symmetrical. No portion **35** is included, but the portion **38** extends upwardly in **FIG. 5** and the section **40** is upwardly indented, shifting the center of applied force of the spring **32***a* upwardly in the embodiment shown in **FIG. 5**.

[0021] Referring to **FIG. 6**, a metal processing carrier **50** may be utilized to secure lids **52** onto integrated circuit dice **56**. In this case, each bridge clip **10** includes a bridge **12** which clips into appropriately sized apertures **53** in the metal processing carrier **50**. Thus, the prongs **37** may rest on the upper surface of the carrier **50**.

[0022] In one embodiment, the apertures **53** provided in the carrier **50** may produce an angled orientation of the bridge clip **12**, as indicated in **FIG. 7**. Depending on the size and location of the lid **56**, it may be desirable to provide an off center loading. In this case, the off center loading may enable the point of maximum force, applied by the leaf spring **32** against the lid **52**, to be off center along the length of the bridge **12** or transverse thereto, as needed, or even, in some cases, off center in both the length and transverse directions.

[0023] The apertures **53** in the carrier **50** receive the end pieces **14** on the bridge **12** and lock the bridge clip **10** thereon. The tongues **51**, defined in the carrier **50**, adjacent the apertures **53**, releasably lock the bridge clip **10** in place. In particular, the end pieces **14** cam inwardly as they engage the apertures **53** until they are pushed sufficiently far to spring back and be locked by the tongues **51** which engage the apertures **16** in the bridge **12** end pieces **14**. In this position, the leaf spring **32** is offset to the right because of the provision of the extension **35**. Off center loading of the lid **52** against the package **56** is possible. Thus, an off center of force may be applied to adhesively secure the lid **52** to the package **56**.

[0024] In some embodiments, off center force may be applied to dice without requiring the provision of different handling media, different bridges, and different stiffeners for each variation. This reduces the inventory of components and the inventory of different assembly techniques, reducing the cost of assembly in some cases. Leaf springs may be modified to accommodate a variety of offset die scenarios. This may be accomplished without requiring different carriers, different stiffeners, or different bridges in some embodiments. Thus, a variety of different sizes and orientations of lids and dice may be accommodated without excessive costs. Similarly, the assembly equipment need not be modified in any way in some embodiments of the present invention.

[0025] While the present invention has been described with respect to a limited number of embodiments, those skilled in the art will appreciate numerous modifications and variations therefrom. It is intended that the appended claims cover all such modifications and variations as fall within the true spirit and scope of this present invention.

What is claimed is:

1. A method comprising:

forming a bridge clip with a leaf spring offset with respect to the centroid of the bridge clip.

2. The method of claim 1 including offsetting said leaf spring along the length of said bridge clip.

3. The method of claim 1 including offsetting said leaf spring transversely to the length of said bridge clip.

4. The method of claim 1 including providing a leaf spring for a bridge clip that has a curved portion and a straight portion, the straight portion being longer on one side of said bridge clip than on the other side.

5. The method of claim 1 including providing a leaf spring having a curved portion and a pair of straight portions on opposed sides of said curved portion, said curved portion having an apex, said apex having an offset portion offset away from the centroid of said leaf spring.

6. A method comprising:

using a bridge clip to provide off center loading between a die and a lid.

7. The method of claim 1 including providing a leaf spring having a curved portion to apply force to said lid, the apex of said curved portion being offset with respect to the centroid of said bridge clip.

8. The method of claim 7 including offsetting said leaf spring along the length of said bridge clip.

9. The method of claim 7 including offsetting said leaf spring transversely to the length of said bridge clip.

10. The method of claim 7 including providing a leaf spring for a bridge clip that has a curved portion and a straight portion, the straight portion being longer on one side of said bridge clip that on the other side.

11. The method of claim 7 including providing a leaf spring having a curved portion and a straight portion and a pair of straight portions on opposed sides of said curved portion, said curved portion having an apex, said apex being offset away from the centroid of said leaf spring.

12. A bridge clip comprising:

a bridge;

a stiffener coupled to said bridge; and

a leaf spring mounted on said stiffener in an offset position.

13. The bridge clip of claim 12 wherein said leaf spring includes a curved portion and two opposed straight portions on either side of said curved portion, one of said straight portions being longer than the other of said straight portions.

14. The bridge clip of claim 12 wherein said leaf spring includes a curved portion and a pair of straight portions on opposite sides of said curved portion, said straight portions to engage said stiffener, said curved portion having an apex and a length, the apex of said curved portion being offset in a direction transverse to the length of said leaf spring.

15. The bridge clip of claim 12 including a pair of louvers in said stiffener, said louvers engaged by said leaf spring,

said louvers being symmetrically positioned on said stiffener.

16. A leaf spring for a bridge clip comprising:

a curved portion; and

two opposed straight portions on either side of said curved portion, one of said straight portions being longer than the other of said straight portions.

17. The leaf spring of claim 16 wherein said straight portions to fit into louvers in a bridge clip.

18. A leaf spring for a bridge clip comprising:

a curved portion; and

a pair of straight portions on opposite sides of said curved portion, said straight portions to engage a stiffener, said curved portions including an apex and a length, the apex of said curved portions being offset in a direction transverse to the length of said leaf spring.

19. The leaf spring of claim 18 wherein the apex is indented on one side and includes an outwardly extending prong on the opposite side.

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