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# METHOD OF BENDING LEADS OF SEMICONDUCTOR PACKAGE

This invention relates to a method of bending outside leads of a semiconductor package into a predetermined "gull wing" shape.

Semiconductor IC packages having gull wing-shaped outside leads are now widely used for mounting on printed wiring boards. Fig. 5 schematically depicts an example of such a semiconductor package designated by the reference numeral 1. The package 1 has one or more side ends (two opposite side ends 1a and 1b in the illustrated case) from which a plurality of parallel leads 2, each coated with a solder layer, extend outward. Thus, the leads 2 are arranged in one direction along each of the side ends 1a and 1b. Each of the leads 2 has a root portion 2a extending outward from the side end, a vertical portion 2b vertically extending from its juncture P with the root portion 2a and a horizontal portion 2c horizontally extending from its juncture Q with the vertical portion 2b and, thus, is a gull wing-like form as a whole.

JP-A-6-224349 proposes a method of producing the above gull wing structure, wherein each of the straight outside leads 2 of a semiconductor package is first bent at the point P to form the root portion 2a and an obliquely downwardly extending leg portion and wherein the leg portion is then bent to form the vertical and horizontal portions 2b and 2c. The second bending step is performed by supporting the package so that the root portions thereof are rested on a portion of a die having a working surface whose shape conforms with the intended final gull wing-like shape of the lead. A punch is moved relative to the die so that the leg portion is engaged by the punch at the point Q and is pushed by the punch. The punch is displaced along a line which is substantially the same as a chord of a circular arc along which the point Q moves. As a result, the leg is bent at the

point Q. The known method is advantageous because the frictional contact between the leads and the working surfaces of the die and punch can be minimized.

The above known method, however, has a problem that the lower surfaces of the horizontal portions of the gull wing-like leads thus produced are not on one plane, especially when the package is warped as shown in Fig. 4. As shown in Fig. 6, the root portions 2a of all leads 2 are nipped between an upper pressing member 13 and a die 14 throughout the first and the second bending steps so that the warp is temporarily corrected during the bending steps. Namely, the underside surfaces 2c of the leads are on the same plane. After released from the die, however, the package 1 returns warped so that the underside surfaces of the horizontal portions 2c of the leads 2 get out of the same plane. As the packages become thinner and thinner, the warp thereof becomes significant. Thus, the surface irregularity of the underside surfaces of the horizontal portions 2c which are to be in contact with wiring patterns of a printed wiring board should be avoided.

The present invention has been made in view of the problem of the conventional lead bending method. In accordance with the present invention, there is provided a method of bending a plurality of parallel leads of a semiconductor package, wherein each of said leads has a root portion extending outward from a side end of said semiconductor package and a leg portion contiguous with said root portion and extending obliquely downward from its juncture P with said root portion, said leg portion having a point Q spaced apart a distance D from said juncture P, said method comprising the steps of:

(a) placing said package on a die located at a predetermined position and comprising a flat top surface adapted for engaging with said root portions of at least part of said plurality of leads, a vertical surface extending

downward from its juncture S with said top surface, and a bottom surface horizontally extending from its juncture T with said vertical surface, said top, vertical and bottom surfaces forming a continuous smooth L-shaped female working surface of said die and the length between the junctures S and T being substantially equal to said distance D, so that each root portion of said at least part of said plurality of leads is rested on said top surface of said die with said juncture P thereof being located at said juncture S of said die and with said leg portion of each of said leads extending obliquely downward toward said bottom surface of said die;

(b) positioning a supporting member having a flat elongated lower side such that said lower side is oriented in parallel with said top surface of said die and that each root portion of said at least part of said plurality of leads is sandwiched between said lower side of said supporting member and said top surface of said die and loosely held therebetween;

(c) positioning a punch at a predetermined location, said punch comprising a first lower wall, a vertical wall extending downward from its juncture U with said first lower wall and a second lower wall horizontally extending from its juncture V with said vertical wall, said first lower, vertical and second lower walls forming a continuous smooth male operating surface matching said working surface of said die and the distance between the junctures U and V being substantially equal to said distance D, so that said juncture V of said punch is in contact with said juncture Q of each of said at least part of said plurality of leads; and

(d) linearly displacing said punch relative to said die along a line extending between said junction V of said punch positioned at said predetermined location and said junction T of said die located at said predetermined position, until said juncture Q of each of said leads is

brought into engagement with said juncture T of said die, so that said leg portion of each of said leads is bent in conformity with the shape of said working surface of said die.

In the present specification and claims, the term "juncture" is intended to mean a boundary and does not imply that separate components are joined or bonded to each other at the juncture.

The present invention will now be described in detail below with reference to the accompanying drawings, in which:

Fig. 1 is a cross-sectional elevational view diagrammatically showing operation of a bending device for carrying out a method of the present invention;

Fig. 2 is a cross-sectional elevational view schematically showing a structure of the bending device of Fig. 1;

Fig. 3(a) is a schematic illustration of a semiconductor package before being bent;

Fig. 3(b) is a schematic illustration showing a preforming step in the method of the present invention;

Fig. 4 is a perspective view schematically illustrating a warped semiconductor package after preforming;

Fig. 5 is a front view of a semiconductor package after bending; and

Fig. 6 is a perspective view, cut away in part, schematically illustrating the state where bending has been completed in accordance with the conventional method.

In the method of the present invention, a plurality of parallel leads 2 extending outward from at least one side end (opposite side ends 1a and 1b in the illustrated case) of a semiconductor package 1 as shown in Fig. 3(a) are first preformed so that each of the leads 2 is bent, as shown in Fig. 3(b), at a point P to provide a root portion 2a extending outward the semiconductor package and a leg portion

2d contiguous with the root portion 2a and extending obliquely downward from its juncture P with the root portion 2a.

The preforming may be carried out by pushing the leads 2 supported on a die 6 with a pair of vertically moveable pushing members 8 each having a tapered lower side. The die 6 has a flat top surface (6a in Fig. 2) adapted for engaging with root portions 2a of the leads 2 and for supporting the package 1 thereon. By lowering the pushing members 8, each of the leads 2 is bent at the point P.

The thus preformed leads 2 are then bent into a predetermined gull wing-like form having two bending points P and Q as shown in Fig. 5. The bending may be carried out using the same die 6 as used in the preforming step. Referring to Fig. 2, the die 6 has a flat top surface 6a adapted for engaging with the root portions 2a of the leads 2, a vertical surface 6b extending downward from its juncture S with the top surface 6a, and a bottom surface 6c horizontally extending from its juncture T with the vertical surface 6b. The top, vertical and bottom surfaces 6a, 6b and 6c form a continuous smooth L-shaped female working surface 16 of the die 6. The length between the junctures S and T is substantially equal to a distance D (Fig. 5) between the points P and Q.

The package 1 having preformed leads 2 is placed on the die 6 so that each of the root portions 2a of the leads 2 is rested on the top surface 6a of the die 6 with the juncture P thereof being located at the juncture S of the die 6 and with the leg portion 2d of each of the leads 2 extending obliquely downward toward the bottom surface 6c of the die 6, as shown by the solid line in Fig. 1.

A supporting member 5 having a flat elongated lower side 5a is then lowered and positioned such that the lower side 5a is oriented in parallel with the top surface 6a of the die 6 and that each root portion 2a of the plurality of

leads 2 is sandwiched between the lower side 5a of the supporting member 5 and the top surface 6a of the die 6, as shown in Fig. 1. In this case, it is important that the root portions 2a should be loosely held between the lower side 5a of the supporting member 5 and the top surface 6a of the die 6. It is preferred that the supporting member 5 be positioned such that the space 7 (Fig. 1) between the lower side 5a and the top surface 6a is greater than the thickness of the root portion 2a. In other words, any of the root portions 2a of the plurality of leads 2 is preferably maintained in disengagement with at least either one of the lower side 5a of the supporting member 5 and the top surface 6a of the die 6.

Thereafter, a punch 3 is positioned at a predetermined location as shown by the solid line in Fig. 1. As best seen in Fig. 2, the punch 3 has a first lower wall 3a, a vertical wall 3b extending downward from its juncture U with the first lower wall 3a and a second lower wall 3c horizontally extending from its juncture V with the vertical wall 3b. The first lower, vertical and second lower walls 3a, 3b and 3c form a continuous smooth male operating surface 13 matching the working surface 16 of the die 6. The distance between the junctures U and V is substantially equal to the distance D, so that, when the punch 3 is position at the predetermined location, the juncture V of the punch is in contact with the juncture Q of each of the plurality of leads 2.

The punch 3 is then linearly displaced relative to the die 6 along a line (broken line in Fig. 1) extending between the junction V of the punch 3 positioned at the predetermined location and the junction T of the die 6 located at the predetermined position, until the juncture Q of each of the leads 2 is brought into engagement with the juncture T of the die 6, so that the leg portion 2d of each of the leads 2 is bent in conformity with the shape of the

working surface 16 of the die 6.

In the method according to the present invention, the preformed leads 2 are bent by being pushed with the punch 3 against the working surface 16 of the die such that the sliding contact between the operating surface 13 of the punch 3 and the leads 2 and between the working surface 16 of the die 6 and the leads 2 is minimized. As a result, a solder layer coated over the surfaces of the leads 2 is hardly separated or abraded therefrom, so that the working and operating surfaces of the punch and die are maintained always clean. Moreover, since the leads 2 of a warped package 1 are bent while retaining the warped state, the underside surfaces of the horizontally extending portions 2c of the bent leads are on the same plane.




WHAT IS CLAIMED IS:

1. A method of bending a plurality of parallel leads of a semiconductor package, wherein each of said leads has a root portion extending outward from a side end of said semiconductor package and a leg portion contiguous with said root portion and extending obliquely downward from its juncture P with said root portion, said leg portion having a point Q spaced apart a distance D from said juncture P, said method comprising the steps of:

placing said package on a die located at a predetermined position and comprising a flat top surface adapted for engaging with said root portions of at least part of said plurality of leads, a vertical surface extending downward from its juncture S with said top surface, and a bottom surface horizontally extending from its juncture T with said vertical surface, said top, vertical and bottom surfaces forming a continuous smooth L-shaped female working surface of said die and the length between the junctures S and T being substantially equal to said distance D, so that each root portion of said at least part of said plurality of leads is rested on said top surface of said die with said juncture P thereof being located at said juncture S of said die and with said leg portion of each of said leads extending obliquely downward toward said bottom surface of said die;

positioning a supporting member having a flat elongated lower side such that said lower side is oriented in parallel with said top surface of said die and that each root portion of said at least part of said plurality of leads is sandwiched between said lower side of said supporting member and said top surface of said die and loosely held therebetween;

positioning a punch at a predetermined location, said punch comprising a first lower wall, a vertical wall extending downward from its juncture U with said first lower

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said first lower wall and a second lower wall horizontally extending from its juncture V with said vertical wall, said first lower, vertical and second lower walls forming a continuous smooth male operating surface matching said working surface of said die and the distance between the junctures U and V being substantially equal to said distance D, so that said juncture V of said punch is in contact with said juncture Q of each of said at least part of said plurality of leads; and

(d) linearly displacing said punch relative to said die along a line extending between said junction V of said punch positioned at said predetermined location and said junction T of said die located at said predetermined position, until said juncture Q of each of said leads is brought into engagement with said juncture T of said die, so that said leg portion of each of said leads is bent in conformity with the shape of said working surface of said die.

2. A method as claimed in claim 1, wherein said package is warped so that, during step (b), any of said root portions of said plurality of leads is maintained in disengagement with at least either one of said lower side of said supporting member and said top surface of said die.

# METHOD OF BENDING LEADS OF SEMICONDUCTOR PACKAGE

## Abstract of the Disclosure

A method of bending a plurality of parallel leads of a semiconductor package, including placing the package on a die, positioning a supporting member such that each root portion is sandwiched between the lower side of the supporting member and the top surface of the die and loosely held therebetween, positioning a punch at a predetermined location, and linearly displacing the punch relative to the die so that each of the leads is bent in conformity with the shape of the working surface of the die.

Fig. 1

FIG. 1

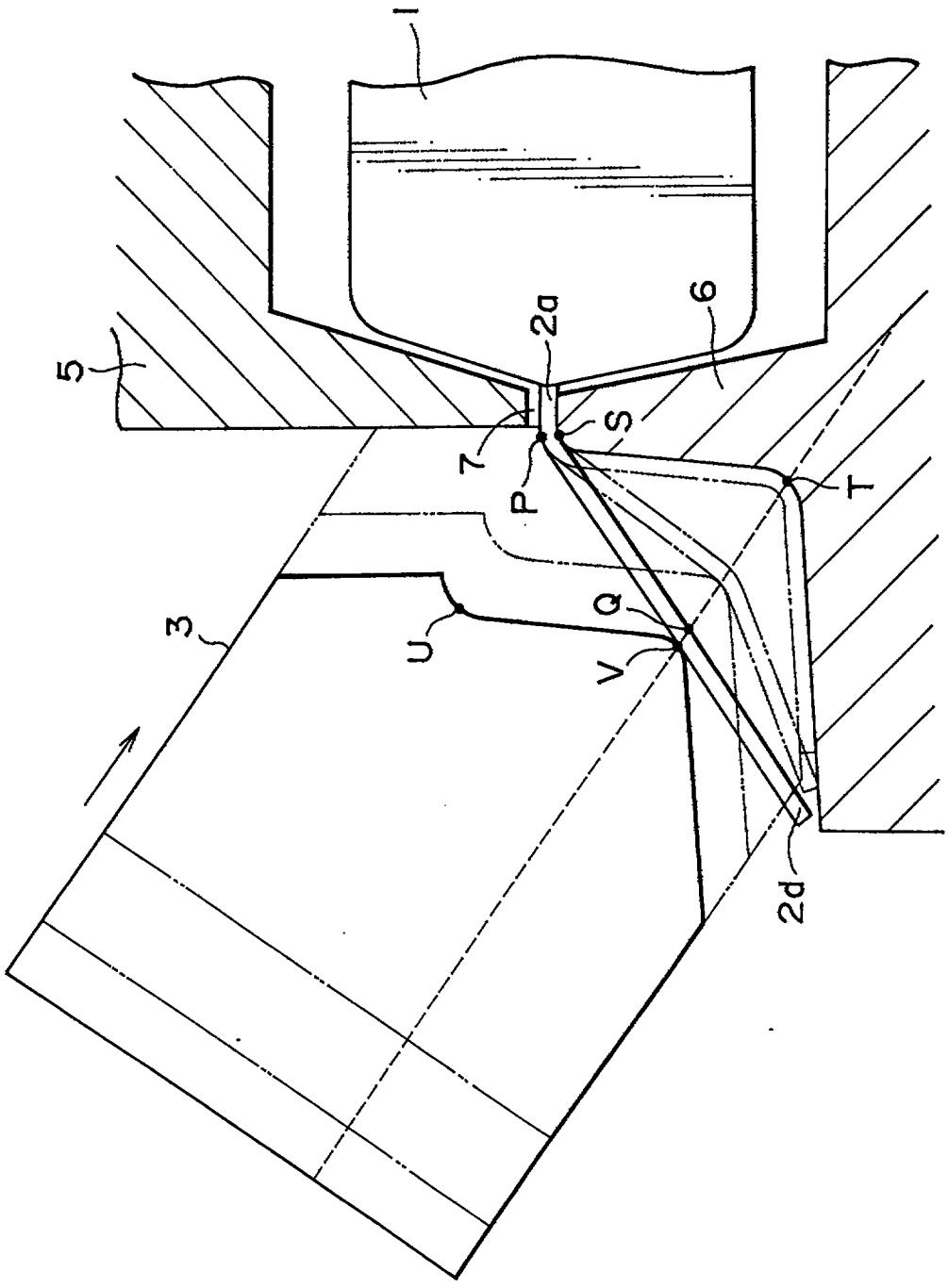


FIG. 2

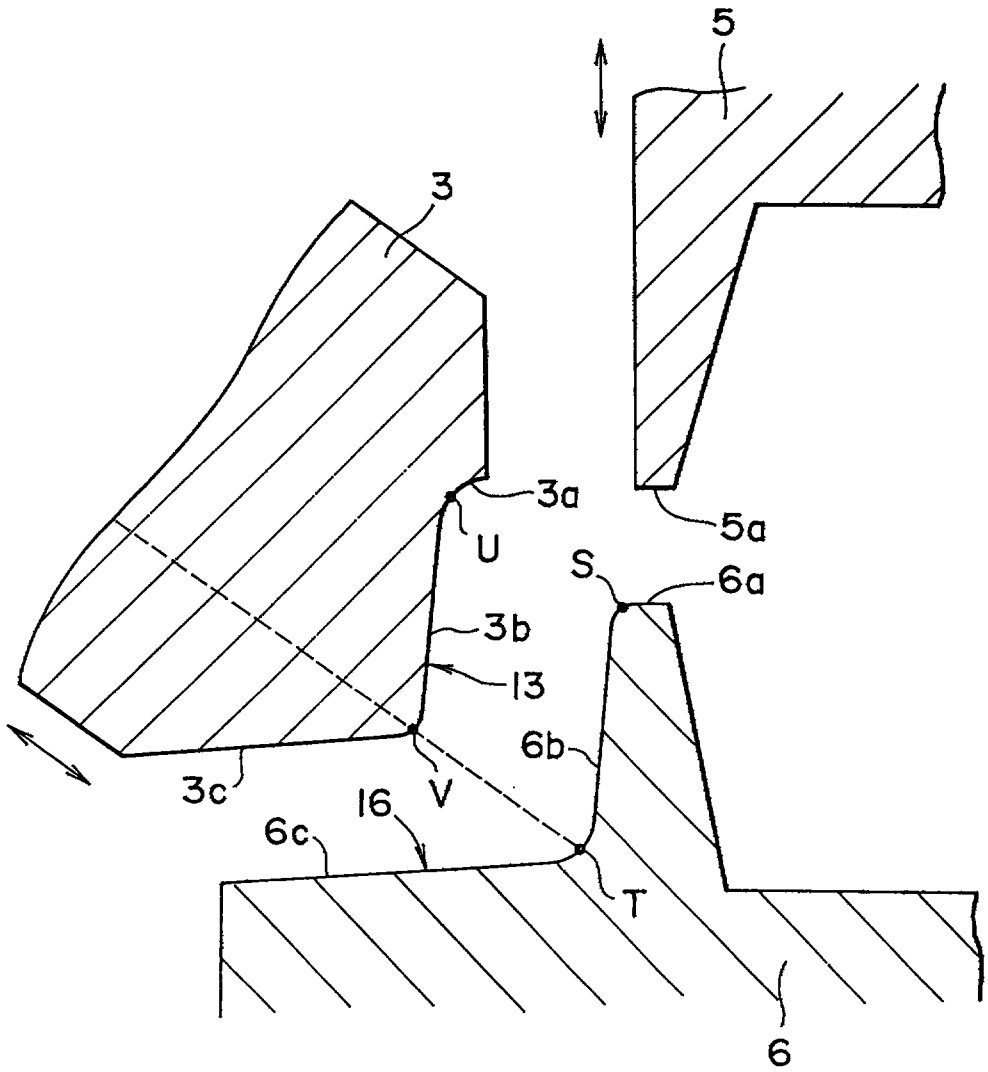


FIG. 3a

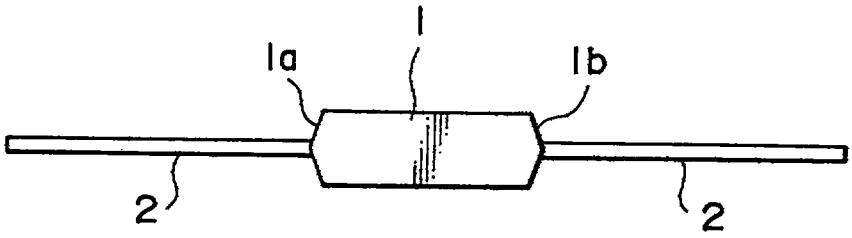



FIG. 3b

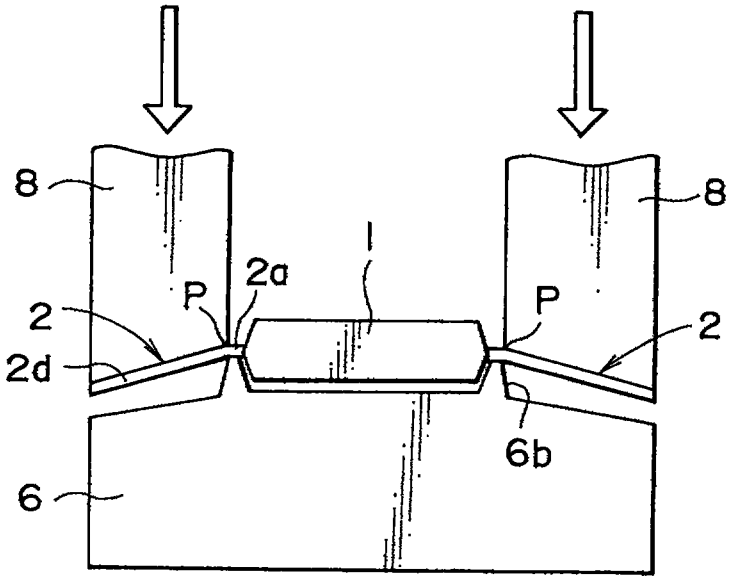


FIG. 4

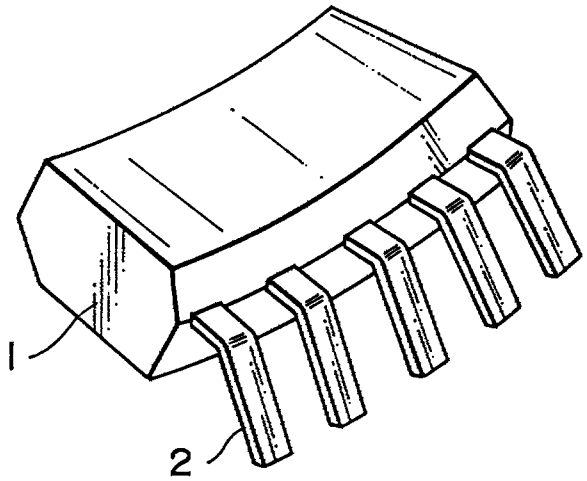



FIG. 5

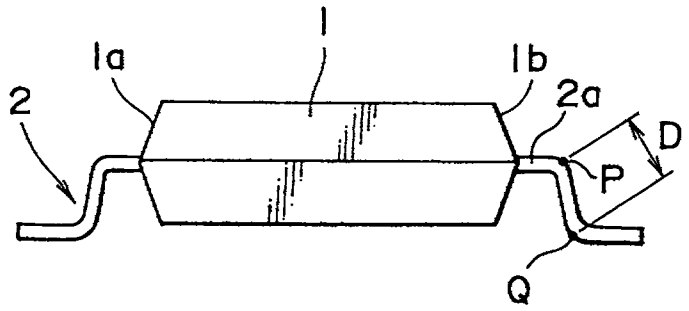


FIG. 6

