LEAD FRAME MANUFACTURING METHOD

BACKGROUND OF THE INVENTION

1. Technical Field

The present invention relates to a lead frame manufacturing method and, more particularly, to a lead frame manufacturing method for manufacturing lead frames by etching a workpiece formed into an elongated member.

2. Related Art

Lead frame manufacturing methods are roughly classified into a group of methods of manufacturing lead frames by stamping, and a group of methods of manufacturing lead frames by etching.

When lead frames are manufactured by stamping, a workpiece constituted by an elongated member is used. Then, lead frames are manufactured by forming a single row of lead frame sheets, each of which includes one or more lead frames, in the elongated workpiece.

On the other hand, when lead frames are manufactured by etching, there are the case of using a workpiece constituted by an elongated member, and the case of using a large sheet. The case of using the workpiece constituted by an elongated member includes the case of manufacturing lead frames by arranging lead frame sheets, each of which includes one or more lead frames, in a single row in the elongated workpiece, and the case of manufacturing lead frames by arranging lead frame sheets, each of which includes one or more lead frames, in multiple rows in the elongated workpiece. In the case of using

a sheet as the workpiece, lead frames are manufactured by arranging lead frame sheets, each of which includes one or more lead frames, in multiple rows in the sheet-like workpiece.

In the case of manufacturing lead frames by etching, the surface of a workpiece is first coated with a photosensitive resist. Subsequently, the photosensitive resist is exposed and developed according to a lead pattern formed on the workpiece thereby to form a resist pattern with which parts to be formed as lead frame sheets, each of which includes one or more lead frames, are coated. Then, the workpiece is etched by using the resist pattern as a mask. Thus, lead frames sheet (or lead frames) are manufactured (See JP-A-53-106572, JP-A-2000-073186 and JP-A-11-061442).

Among the methods of manufacturing lead frames, the method of manufacturing lead frames by utilizing stamping has an advantage of high-speed processing ability and also has a problem in that the number of products taken from a workpiece is limited because lead frames are formed in the workpiece by forming lead frame sheets, each of which includes one or more lead frames, in a single row.

On the other hand, the method of manufacturing lead frames by utilizing etching has advantages that the number of products taken from a workpiece is large because the products can be surface-mounted in multiple rows, whereas a high-degree of surface-mounting precision (or exposure precision) is needed for surface-mounting the lead frame sheets, each of which includes one or more lead frames, in multiple rows. Therefore, in the case of manufacturing lead frames by

utilizing etching to thereby surface-mount products in multiple rows, generally, a method of using a sheet-like workpiece and forming an etching pattern for each sheet of the workpiece to thereby manufacture lead frames is employed.

However, in the case of forming an etching pattern for lead frame sheets, each of which includes one or more lead frames, in the sheet-like workpiece, it is necessary to leave frame-like peripheral portions of the workpiece for conveying the workpiece. This causes the problem that the material of the workpiece is wasted because such peripheral portions thereof become scrap areas.

This problem can be avoided by using a workpiece, which is constituted by an elongated member formed in such a way as to be broad to the extent that lead frame sheets, each of which includes one or more lead frames, can be arranged in multiple rows, instead of the sheet-like workpiece, and arranging the lead frame sheets in multiple rows. FIG. 4 illustrates a method of arranging the lead frame sheets 6, each of which includes four lead frames, in multiple rows in a workpiece 5 formed into an elongated member. In this figure, parts A are exposure areas, each of which is exposed one time.

However, in a case where the etching pattern is formed in the workpiece 5 as shown in FIG. 4, it is necessary that the adjoining exposure areas A are disposed close to each other in such a way as to prevent occurrence of scrap areas as much as possible, or that the exposure areas A are exposed with a high degree of positioning precision in such a manner as to be continuously disposed and as

to reduce the width W shown in FIG. 4 to zero. At that time, the displacement of an exposure position and the inclination of the exposure area should be prevented (in the figure, a part B is an example of an inclined exposure area). The method of disposing the lead frame sheets, each of which includes one or more lead frames, in multiple rows in the workpiece 5 constituted by an elongated member is effective in production efficiency. However, the size of the exposure area to be exposed one time increases. Even when the exposure area is slightly inclined, a large error occurs. A high degree of technical accuracy is required for accurately connecting and exposing the exposure areas. Further, this method has the problem that the positional precision of the exposure position is degraded, because the value of the width of the workpiece 5 itself varies and surges.

SUMMARY OF THE INVENTION

Accordingly, the invention is accomplished to solve these problems. An object of the invention is to provide a method of manufacturing lead frames by etching, which uses a workpiece constituted by an elongated member, and which does not particularly need a high degree of precision of exposure of an etching pattern for forming the lead frames and is enabled to reduce an amount of scrap generated in a manufacturing process and to efficiently manufacture the lead frames.

To achieve the foregoing object of the invention, according to the invention, there is provided a lead frame manufacturing method

comprising:

forming an etching pattern in a workpiece constituted by an elongated member, the etching pattern including a pattern for forming at least one lead frame sheet, which includes at least one lead frame, and a pattern for forming at least one connecting portion, which connects edges of the lead frame sheets adjoining in a longitudinal direction of the workpiece;

etching the workpiece by using the etching pattern as a mask, to thereby form an elongated lead-frame body, which includes the lead frame sheets connected to each other through the connecting portion; and

separating a connection part, which is provided between the connecting portion and the lead frame sheet, from the elongated lead-frame body thereby to obtain the lead frame sheet.

Further, the lead frame manufacturing method according to the invention may feature that a pattern for disposing the lead frame sheets in multiple rows on the workpiece is provided as the pattern for forming the lead frame sheet; and the lead frame sheet are obtained from the elongated lead-frame body in which the lead frame sheets are disposed in multiple rows. Thus, the lead frames can efficiently be manufactured by disposing the lead frame sheets in multiple rows.

Furthermore, the lead frame manufacturing method according to the invention may feature that a pattern for forming at least one supporting piece, which connects between edges of the lead frame sheets, is provided as the pattern for forming the connecting portion;

and the lead frame sheet is obtained from the elongated lead-frame body by separating the connection part between the supporting piece and the lead frame sheet. A single or plurality of the supporting pieces may be provided at the edges of the lead frames. The supporting pieces can easily be separated from the lead frames by forming the supporting pieces in such a way as to be narrow, and by cutting the connection parts between the supporting pieces and the lead frames.

Additionally, the lead frame manufacturing method according to the invention may feature that a pattern for forming a supporting bar, which connects rail portions of the workpiece, and also forming a supporting piece, which connects between the supporting bar and an edge of the lead frame sheet, is provided as the pattern for forming the connecting portion; and the lead frame sheet is obtained from the elongated lead-frame body by separating the connection part between the supporting piece and the lead frame. The supporting bar and the supporting pieces may be formed in such a way as to be narrow, so that the bonding part between the lead frame sheets can be formed in such a manner as to be narrow. Consequently, the supporting pieces can easily be separated from the lead frame sheets by easily cutting the connection parts between the supporting pieces and the lead frame sheets.

In accordance with the lead frame manufacturing method according to the invention, the connecting portions are provided between the edges of the lead frame sheets, each of which one or more lead frames. The lead frame sheets are formed in such a way as to be consecutively

provided in the longitudinal direction thereof. Consequently, the connecting portions act in such a manner as to degrade the precision with which the etching patterns are formed in the workpiece. Especially, an operation of forming in the elongated workpiece the etching pattern for disposing the lead frame sheets, each of which includes one or more lead frames, in multiple rows can be facilitated. The lead frame manufacturing method according to the invention can suitably be utilized for the mass production of lead frames.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an explanatory view illustrating a lead frame manufacturing method according to the invention.

FIG. 2 is an enlarged explanatory view illustrating a lead frame sheet and a connecting portion.

FIGS. 3(a) to 3(c) are explanatory views respectively illustrating other examples of the configuration of the connecting portion.

FIG. 4 is an explanatory view illustrating a related method of forming a pattern of lead frames by using a workpiece constituted by an elongated member.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, preferred embodiments of the invention are described in detail with reference to the accompanying drawings.

FIG. 1 shows a state wherein an elongated lead-frame body is

formed by a lead frame manufacturing method according to the invention, which uses an elongated workpiece 10. Here, the elongated lead-frame body means a group of lead frame sheets 12 which are connected to each other in a longitudinal direction of the elongated workpiece 10. The lead frame sheet 12 includes one lead frame or lead frames formed like a sheet.

The lead frame manufacturing method according to the invention features that the lead frame sheets 12 are surface-mounted in multiple rows on the workpiece 10 formed into an elongated member, and that after the elongated lead-frame body, in which a predetermined lead pattern is formed, is formed by etching the workpiece 10, the lead frame sheets 12 are individually separated from the elongated lead-frame body to thereby obtain a product of a lead frame sheet.

The elongated lead-frame body in which the lead frame sheets arranged in the longitudinal direction of the workpiece 10 shown in FIG. 1 is obtained by the following process. That is, first, photosensitive resist films are laminated on the surface of the workpiece 10. Alternatively, the surface of the workpiece 10 is coated with a photosensitive resist material. Thus, the surface of the workpiece 10 is covered with the photosensitive resist. Thereafter, the photosensitive resist is exposed and developed in a predetermined pattern. Consequently, a resist pattern, from which a part to be removed by etching is exposed, is formed. Then, the workpiece 10 is etched by using the resist pattern as a mask.

The lead frame manufacturing method according to this embodiment

features that an etching pattern is formed on the surface of the workpiece 10 in such a way as to include a lead pattern for forming the lead frame sheets 12 and a pattern for forming a connecting portion 14, which connects the edges of the lead frame sheets 12 adjoining in a longitudinal direction of the workpiece 10 to each other.

That is, as shown in FIG. 1, a part A is an area to be exposed by performing an exposure operation one time. This exposure area A includes the lead pattern for forming the lead frame sheets 12 and the pattern for forming the connecting portion 14, which connects the edges of the lead frame sheets 12 to each other.

Thus, the etching pattern, which has both the lead pattern for forming the lead frame sheets 12 and the pattern for forming the connecting portion 14, is formed on the surface of the workpiece 10. Then, the workpiece 10 is etched by using this etching pattern as the mask. Consequently, an elongated lead-frame body in which the lead frame sheets 12 are arranged in the longitudinal direction of the workpiece 10 shown in FIG. 1 can be obtained.

FIG. 2 enlargedly illustrates the configuration of each of the lead frame sheets 12 and the connecting portion 14. The connecting portion 14 comprises a supporting bar 14a, which connects rail portions 16, 16 continuously formed in the longitudinal direction along side edge portions of the elongated lead-frame body, and also comprises a supporting piece 14b connecting the supporting bar 14a to the edge of each of the lead frame sheets 12. The elongated lead-frame body is formed in this embodiment so that the two supporting pieces 14b,

14b are connected to the edge of each of the lead frame sheets 12, and so that each of the lead frame sheets 12 is hung and supported on the edge in the longitudinal direction thereof by the supporting bar 14a through the supporting pieces 14b. In this embodiment, the two supporting pieces 14b are connected to the edge of each of the lead frame sheets 12; however, the number of supporting pieces 14b for each of the lead frame sheets 12 are not limited to this.

In order to obtain the lead frame sheets from the elongated lead-frame body shown in FIGS. 1 and 2, it is sufficient to separate the supporting pieces 14b, which are connected to the edges of the lead frame sheets 12, from the lead frame sheets 12 in the elongated lead-frame body.

Methods of separating the connecting portion 14 can be implemented by a method of cutting each of connection parts, which are provided between the supporting pieces 14b and the lead frame sheets 12, along the outer position of an associated one of the lead frame sheets 12 by using an NC punch, and a method of punching out the connection parts between the supporting pieces 14b and the lead frame sheets 12 by slit-punching.

Methods of cutting the connection parts between the supporting pieces 14b and the lead frame sheets 12 by machine works, such as the use of an NC punch and the slit punching, and separating the supporting pieces 14b from the lead frame sheets 12 can achieve the accurate separation of the supporting pieces 14b from the lead frame sheets 12 by detecting the connection positions between the supporting

pieces 14b and the lead frame sheets 12.

As shown in FIG. 2, a reference hole 18 is provided in each of the supporting bars 14a so that the connection part between the supporting piece 14b and the lead frame sheet 12 can accurately be detected by using a sensor or the like. Also, a guide hole 20 for conveying and positioning the elongated lead-frame body may be provided in each of the rail portions 16.

The lead frame manufacturing method according to this embodiment also features that when the etching pattern (that is, the resist pattern) is formed in the workpiece 10 that is formed into an elongated member, the etching pattern is set in such a way as to include the lead pattern for forming the lead frame sheets 12 and the pattern for forming the connecting portion 14, which connects the lead frame sheets 12 adjoining in the longitudinal direction of the workpiece 10, that when the elongated lead-frame body is formed by etching the workpiece 10, the edges of the lead frame sheets 12 adjoining in the longitudinal direction are connected to each other through the connecting portion 14, and that the connecting portion 14 is separated from the lead frame sheets 12 in a post-process to thereby obtain products of lead frame sheets.

Because the lead frame sheets 12 adjoining in the longitudinal direction are supported by the supporting bar 14a through the supporting pieces 14b each formed in such a way as to be narrow, the lead frame sheet 12 can easily be obtained by separating the supporting pieces 14b from the lead frame sheets 12 at the boundary

positions therebetween.

Even in a case where the bonding part between the etching patterns is slightly displaced when the etching patterns are formed on the workpiece 10, the method of separating the supporting pieces 14b from the lead frame sheets 12 at the connection positions therebetween to thereby obtain the lead frame sheets can easily achieve the recognition of the connection parts between the supporting pieces 14b and the lead frame sheets 12 and the cutting of the connection parts thereat by using an NC punch or the like. That is, even when the slight displacement of the etching patterns formed on the workpiece 10 occurs, the lead frame manufacturing method according to this embodiment can obtain the lead frame sheets.

Thus, even in a case where the slight displacement of the etching patterns occurs when the etching patterns are formed in the workpiece 10, the lead frame manufacturing method according to this embodiment can easily obtain the products of lead frames by separating each of the lead frame sheets respectively from the elongated lead frame body. Thus, this method has an advantage that a high degree of accuracy, which would be needed by the related art, is not required when the etching patterns are formed in multiple rows in the workpiece 10. Consequently, the degree of the precision, which is required when the lead frame sheets are formed in multiple rows in the elongated workpiece 10, is lowered. Thus, the lead frame sheets can be formed in multiple rows by utilizing a conventional apparatus.

Although FIG. 1 shows an example of arranging the lead frame

sheets 12 in four rows, the number of rows of the lead frame sheets 12 is not limited thereto. The lead frame sheets 12 can easily be arranged in multiple rows, the number of which is equal to or more than 5. Also, even in the case of arranging the lead frame sheets 12 in a single row, the method according to the invention is effective. Further, FIG. 1 also shows an example of the lead frame sheet 12 having four lead frames; however, the number of the lead frames in the lead frame sheet 12 is not limited thereto. The lead frame sheet 12 may have lead frames, the number of which is one or equal to or more than 5.

Further, even in a case where the workpiece 10 is slightly undulated in the direction of width thereof, predetermined lead frame sheets 12 can be obtained by forming the etching pattern of the lead frame sheets 12 and the connecting portion 14 within the width of the workpiece 10.

FIGS. 3(a) to 3(c) show examples of the configuration of the connecting portion 14 supporting the lead frame sheets 12, respectively. FIG. 3(a) shows an example in which the supporting piece 14b is directly connected to the side edge portions of the lead frame sheets 12. FIG. 3(b) shows an example in which runouts 14c and 14d are provided on both sides of the connecting portion and in the lead frame sheets 12. FIG. 3(c) shows an example in which the supporting piece 14b is formed in such a way as to be narrow, as compared with those shown in FIGS. 3(a) and 3(b).

Thus, the supporting piece 14b for connecting the lead frame

sheets 12 may have a given shape. The position of the supporting piece 14b and the number of the supporting pieces 14b can appropriately be set according to the quality of the material thereof and to the thickness thereof.

Although this embodiment is configured so that the supporting pieces 14b are connected to the edges in the longitudinal direction of the lead frame sheets, the connecting portion 14 may be provided between the lead frame sheets 12 adjoining in the direction of width thereof so that the lead frame sheets hang and support each other. That is, the lead frames 12 adjoining the rail portion 16 may be adapted to be supported by the rail portion 16 by disposing the supporting pieces between the rail portion 16 and the side edge of each of the lead frame sheets 12. The lead frame sheets 12 provided at middle positions in the direction of width may be adapted by disposing the supporting piece between the side edges of the lead frame sheets 12 so that the lead frame sheets hang and support each other through the supporting piece. The supporting pieces disposed in the direction of width thereof can be separated by using an NC punch or by slit-punching, similarly to the case of separating the supporting pieces 14b connected to the edges of the lead frame sheets 12 by using an NC punch or the like. Thus, the lead frame sheets can easily be obtained. In this case, a reference hole may be provided in each of the rail portions 16 or each of the supporting pieces so that the connection parts between the supporting pieces 14b and the lead frame sheets 12 can accurately be detected by using a sensor

or the like.

Further, although this embodiment is configured so that both of the supporting bars 14a and the supporting pieces 14b are provided as the connecting portion 14, the connecting portion 14 may be provided with only the supporting pieces 14b connecting edges of the lead frame sheets 12 adjoining in the longitudinal direction of the workpiece. In this case, in order to prevent the supporting pieces 14b from bending due to the weight of the lead frame sheets 12, preferably, the connecting portion 14 may have also supporting pieces for connecting between the lead frame sheets 12 or the lead frame sheet 12 and the rail portion 16 which adjoin in the direction of width thereof so that the lead frame sheets 12 or the lead frame sheet 12 and the rail portion 16 hang and support each other in the direction of width thereof.

As described above, according to the lead frame manufacturing method of this embodiment, the lead frame sheets 12 are connected to each other through the supporting bar 14a and the supporting pieces 14b. Thus, an amount of scrap, which is generated when the lead frame sheets are formed in the elongated lead-frame body, can be reduced, as compared with the case of forming the lead frame sheets 12 in multiple rows by using a large sheet. Furthermore, the waste of the material can be reduced by decreasing the width of the area, in which the connecting portion 14 is formed, as much as possible when the lead frame sheets 12 are surface-mounted on the workpiece 10.

I/we claim:

1. A lead frame manufacturing method comprising:

forming an etching pattern in a workpiece constituted by an elongated member, the etching pattern including a pattern for forming at least one lead frame sheet, which includes at least one lead frame, and a pattern for forming at least one connecting portion, which connects edges of the lead frame sheets adjoining in a longitudinal direction of the workpiece;

etching the workpiece by using the etching pattern as a mask, to thereby form an elongated lead-frame body, which includes the lead frame sheets connected to each other through the connecting portion; and

separating a connection part, which is provided between the connecting portion and the lead frame sheet, from the elongated lead-frame body thereby to obtain the lead frame sheet.

2. The lead frame manufacturing method according to claim 1, wherein:

a pattern for disposing the lead frame sheets in multiple rows on the workpiece is provided as the pattern for forming the lead frame sheet; and

the lead frame sheet are obtained from the elongated lead-frame body in which said lead frame sheets are disposed in multiple rows.

3. The lead frame manufacturing method according to claim

1 or 2, wherein:

a pattern for forming at least one supporting piece, which connects between edges of the lead frame sheets, is provided as the pattern for forming the connecting portion; and

the lead frame sheet is obtained from the elongated lead-frame body by separating the connection part between the supporting piece and the lead frame sheet.

4. The lead frame manufacturing method according to claim 1 or 2, wherein:

a pattern for forming a supporting bar, which connects rail portions of the workpiece, and also forming a supporting piece, which connects between the supporting bar and an edge of the lead frame sheet, is provided as the pattern for forming the connecting portion; and

the lead frame sheet is obtained from the elongated lead-frame body by separating the connection part between the supporting piece and the lead frame.

5. The lead frame manufacturing method according to claim 1 or 2, wherein:

a pattern for forming at least one first supporting piece, which connects between edges of the lead frame sheets adjoining in the longitudinal direction of the workpiece, and also forming a pattern for forming at least one second supporting piece, which connects

between edge of the lead frame sheet and a rail portion of the workpiece, is provided as the pattern for forming the connecting portion; and

the lead frame sheet is obtained from the elongated lead-frame body by separating the connection parts between the one and second supporting pieces and the lead frame sheet.

6. The lead frame manufacturing method according to claim 2, wherein:

a pattern for forming at least one first supporting piece, which connects between edges of the lead frame sheets adjoining in the longitudinal direction of the workpiece, forming a pattern for forming at least one second supporting piece, which connects between edge of the lead frame sheet and a rail portion of the workpiece, and also forming at least one third supporting piece, which connects between edges of the lead frame sheets adjoining in a direction perpendicular to the longitudinal direction of the workpiece, is provided as the pattern for forming the connecting portion; and

the lead frame sheets are obtained from the elongated lead-frame body, in which the lead frame sheets are disposed in multiple rows, by separating the connection parts between the one, second and third supporting pieces and the lead frame sheets.