

DESCRIPTION

CONVEYING APPARATUS FOR LEAD FRAME BASE

TECHNICAL FIELD

The present disclosure relates to a conveying apparatus for a lead frame base.

BACKGROUND ART

A lead frame is used as internal wiring of a semiconductor package. This lead frame is produced by processing a lead frame base that is strip-shaped sheet metal.

The lead frame base wound into a coil around an unwinding roll is unwound from the unwinding roll and is conveyed downstream by a conveying apparatus. Thereafter, the lead frame base is wound by a winding roll. In a conveyance process from unwinding the lead frame base from the unwinding roll to winding the lead frame base around the winding roll, the lead frame base is successively subjected to various kinds of processes (e.g., resist film formation process, etching process, and plating process).

JP-A-7-237746 discloses an example of a conveying apparatus for a lead frame base.

The conveying apparatus conveys a lead frame base having a principal surface extending in a horizontal direction (hereinafter, referred to as "prone lead frame base" as appropriate).

CITATION LIST

PATENT LITERATURE

PATENT LITERATURE 1: JP-A-7-237746

SUMMARY

Generally, a lead frame base is very thin (e.g., approximately 0.1 mm to 0.5 mm). Therefore, the lead frame is very easily bent. Thus, in some cases, a conventional conveying apparatus is demanded to provide a large number of support rollers that support side edges of a lead frame base from a lower side with a narrow pitch in order to restrain the lead frame base from being bent in a conveyance direction (direction of travel) thereof. Further, even if the large number of support rollers are used as described above, the center of the lead frame base in a width direction thereof may be bent in a case where the lead frame base has a wide width. In addition, an unnecessary portion of the lead frame base is removed by etching or the like as the lead frame base is conveyed downstream. Therefore, the center of the lead frame base in the width direction tends to be bent in particular.

When such bending occurs in a portion to be processed in the conveyance process of the lead frame base, processing accuracy of the lead frame base is reduced. Consequently, it is difficult for the processed lead frame to have a shape conforming to a design. In view of this, it is also considered that support rollers that support the center of the lead frame base in the width direction are further arranged. However, the center is an important portion functioning as a semiconductor package. Therefore, it is necessary to meet demand to avoid a risk of causing deformation, damage, or the like in/to the center and a risk of causing foreign matters to enter the center due to contact with the support rollers.

In view of this, in the present disclosure, there will be described a conveying apparatus for a lead frame base capable of improving processing accuracy of a lead frame base.

A conveying apparatus for a lead frame base according to a standpoint of the present disclosure includes: a pair of first rollers configured to clamp a lower edge of a

lead frame base having a principal surface extending in a vertical direction; a first rotary device configured to rotate at least one of the pair of first rollers; a first driving device configured to move the pair of first rollers relatively closer to or further from each other; and a controller configured to execute a first process and a second process. In the first process, the lead frame base having the lower edge clamped by the pair of first rollers is conveyed by the first rotary device controlled by the controller to rotate at least one of the pair of first rollers, and in the second process, the first driving device is controlled by the controller to intermittently move the pair of first rollers relatively closer to or further from each other causing the pair of first rollers to repeatedly clamp and release the lower edge at predetermined intervals.

According to this conveying apparatus for a lead frame base, it is possible to improve processing accuracy of a lead frame base.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view illustrating an example of a conveying apparatus for a lead frame base; and

Fig. 2 is a view of a portion in the vicinity of an upstream conveyance portion and a downstream conveyance portion, which is seen from a conveyance direction of a lead frame base.

DETAIL DESCRIPTION OF THE EMBODIMENTS

An embodiment (this embodiment) according to the present disclosure described below is an example for describing a conveying apparatus for a lead frame base of the present disclosure. The conveying apparatus for a lead frame base of the present disclosure is not limited to the following description.

<<Overview of Embodiment>>

[1] First Aspect

A conveying apparatus for a lead frame base according to a first aspect in an embodiment of the present disclosure includes: a pair of first rollers configured to clamp a lower edge of a lead frame base having a principal surface extending in a vertical direction; a first rotary device configured to rotate at least one of the pair of first rollers; a first driving device configured to move the pair of first rollers relatively closer to or further from each other; and a controller configured to execute a first process and a second process. In the first process, the lead frame base having the lower edge clamped by the pair of first rollers is conveyed by the first rotary device controlled by the controller to rotate at least one of the pair of first rollers, and in the second process, the first driving device is controlled by the controller to intermittently move the pair of first rollers relatively closer to or further from each other causing the pair of first rollers to repeatedly clamp and release the lower edge at predetermined intervals.

In the conveying apparatus for a lead frame base according to the first aspect, the first rotary device controlled by the controller rotates at least one of the pair of first rollers clamping the lower edge of the lead frame base. With this, the lead frame base having the principal surface extending in the vertical direction (hereinafter, referred to as "standing lead frame base" as appropriate) is conveyed. The lead frame base is strip-shaped sheet metal. Therefore, bending caused by gravity is smaller on the principal surface of the standing lead frame base than on a principal surface of a prone lead frame base. Thus, it is unnecessary to support the center thereof in a width direction of the lead frame base (hereinafter, simply referred to as "width direction" as appropriate) with support rollers for the purpose of restraining the lead frame base from being bent. This restrains the lead frame base from being bent and deformed.

Therefore, it is possible to improve processing accuracy of the lead frame base. In addition, when the standing lead frame base is conveyed, a uniform process is easily performed on both surfaces of the lead frame base. Further, it is unnecessary to provide a large number of support rollers for supporting the principal surface (lower surface) of the lead frame base, as compared to a case where the prone lead frame base is conveyed. This makes it possible to reduce the number of components.

By the way, when the standing lead frame base is conveyed by the pair of first rollers, force pressed by the other roller in a horizontal direction and frictional force applied downward in the vertical direction by the lead frame base slipping downward due to gravity are applied to the pair of first rollers. That is, force applied in the horizontal direction and force applied upward in the vertical direction, which serve as reaction force from the pair of first rollers, are applied to the lead frame base. Therefore, the lead frame base gradually rises from the pair of first rollers in the conveyance process. When such a rise is ignored, the lead frame base finally comes off the pair of first rollers. Consequently, it may be possible that the lead frame base cannot be conveyed. In view of this, in the conveying apparatus for a lead frame base according to the first aspect, the first driving device controlled by the controller intermittently moves the pair of first rollers relatively closer to or further from each other. In this way, the lower edge is repeatedly clamped by and released from the pair of first rollers at predetermined intervals. Therefore, the lower edge is released from the pair of first rollers when the lead frame base rises. Thereafter, when the lead frame base falls by a predetermined amount, the lower edge is clamped by the pair of first rollers. Thus, the rise of the lead frame base is corrected by momentary release from the pair of first rollers. Consequently, it is possible to convey the lead frame base as appropriate.

[2] Second Aspect

The apparatus according to the first aspect may further include: a pair of second rollers arranged on an upstream side of the pair of first rollers in a conveyance direction of the lead frame base and configured to clamp the lower edge of the lead frame base having the principal surface extending in the vertical direction; a second rotary device configured to rotate at least one of the pair of second rollers; and a second driving device configured to move the pair of second rollers relatively closer to or further from each other. The controller may be configured to execute a third process and a fourth process; and in the third process, the lead frame base having the lower edge clamped by the pair of second rollers may be conveyed by the second rotary device controlled by the controller to rotate at least one of the pair of second rollers, and in the fourth process, the second driving device may be controlled by the controller to intermittently move the pair of second rollers relatively closer to or further from each other causing the pair of second rollers to repeatedly clamp and release the lower edge at predetermined intervals so that the pair of second rollers clamps the lower edge at least when the pair of first rollers releases the lower edge and the pair of first rollers clamps the lower edge at least when the pair of second rollers releases the lower edge. In this case, the lower edge of the lead frame base is clamped by at least one of the pair of first rollers and the pair of second rollers. Therefore, even when one of the pair of first rollers and the pair of second rollers releases the lower edge, the other pair clamps the lower edge and conveys the lead frame base. This makes it possible to continuously convey the lead frame base. In particular, when the lead frame base is not continuously conveyed at the time of processes such as a resist film formation process, an etching process, a plating process, an exposure process, and a resist film removal process, conveyance is temporarily stopped. Therefore, processing time

becomes inconstant. This may vary a thickness of a resist film, an etching amount, a thickness of a plating film, an exposure amount, a removal amount of a resist film, and the like. However, according to the apparatus of the second aspect, the lead frame base is continuously conveyed. This makes it possible to remarkably restrain such variations.

[3] Third Aspect

In the fourth process, the lower edge may be clamped by both the pair of first rollers and the pair of second rollers. This eliminates conveyance failures of the lead frame base due to the lower edge not being clamped either by the pair of first rollers or by the pair of second rollers. Therefore, it is possible to achieve continuous conveyance of the lead frame base more securely.

[4] Fourth Aspect

In the apparatus according to the second or third aspect, clamp time of the lower edge by the pair of first rollers may be longer than clamp time of the lower edge by the pair of second rollers. By the way, in a case where the lead frame base clamped by the pair of first rollers or the pair of second rollers is conveyed, extrusion force is applied to a portion of the lead frame base, the portion being positioned on a downstream side of those rollers. However, the lead frame base is strip-shaped sheet metal. Therefore, when the extrusion force is applied to the lead frame base, the lead frame base is very easily buckled. In view of this, in the apparatus according to the third aspect, the lead frame base is mainly conveyed by the pair of first rollers positioned downstream. That is, the pair of first rollers positioned downstream functions as main driving rollers. In this case, a portion of the lead frame base, which is positioned on a downstream side of the main driving rollers, is comparatively short. This reduces an influence of extrusion force applied by the main driving rollers.

Therefore, it is possible to restrain the lead frame base from being deformed.

[5] Fifth Aspect

Any apparatus according to each of the second to fourth aspects may further include a pair of guide members arranged between the pair of first rollers and the pair of second rollers. The pair of guide members may be configured to guide an upper edge and the lower edge of the lead frame base in the conveyance direction. In this case, the upper edge and lower edge of the lead frame base are guided by the pair of guide members. This makes it possible to restrain the lead frame base from being horizontally shaken with respect to the conveyance direction.

[6] Sixth Aspect

Any apparatus according to each of the first to fifth aspects may further include a stopper member configured to restrain a fall of the lead frame base. In this case, the lead frame base fallen due to release from the pair of first rollers is received by the stopper member. This makes it possible to restrain the lead frame base from being unnecessarily fallen.

<<Example of Embodiment>>

Hereinafter, an example of an embodiment according to the present disclosure will be described in more detail with reference to the drawings. In the following description, the same elements or elements having the same function are denoted by the same reference sign. Repeated description will be omitted.

[Conveying Apparatus for Lead Frame Base]

A conveying apparatus 1 for a lead frame base LF that is strip-shaped sheet metal will be described with reference to Fig. 1 and Fig. 2. The conveying apparatus 1 is configured to convey the lead frame base LF having a standing principal surface (a principal surface of the lead frame base LF extending in the vertical direction).

In a conveyance direction of the lead frame base LF by the conveying apparatus 1 (hereinafter, simply referred to as "conveyance direction" as appropriate), an unwinding roll (not illustrated) for unwinding the lead frame base LF is positioned on an upstream side of the conveying apparatus 1 and a winding roll (not illustrated) for winding the lead frame base LF is positioned on a downstream side of the conveying apparatus 1. For example, a processing device for performing processes such as a resist film formation process, an exposure process, an etching process, a resist film peeling process, and a plating process on the lead frame base LF may be arranged between the unwinding roll and the conveying apparatus 1. For example, an inspection device for inspecting the lead frame base LF or the like may be arranged between the conveying apparatus 1 and the winding roll.

As illustrated in Fig. 1, the conveying apparatus 1 includes an upstream conveyance portion 10, a downstream conveyance portion 20, a plurality of guides 30, a stopper member 40, a sensor 50, and a controller 60.

As illustrated in Fig. 1 and Fig. 2, the upstream conveyance portion 10 includes a pair of upstream rollers 11 and 12 (second rollers), a rotary device 13 (second rotary device), a driving device 14 (second driving device), and a rocking member 15. The pair of upstream rollers 11 and 12 is arranged so that a lower edge LFa of the lead frame base LF is interposed therebetween. That is, the pair of upstream rollers 11 and 12 faces each other via the lower edge LFa. Both the upstream rollers 11 and 12 have a cylindrical shape and are rotatable around a rotation axis extending in the vertical direction.

The rotary device 13 is connected to the upstream roller 11. The rotary device 13 is, for example, a rotating motor. The rotary device 13 operates on the basis of an instruction from the controller 60 to rotatably drive the upstream roller 11.

The driving device 14 is connected to the rocking member 15. The driving device 14 is, for example, a rocking servomotor. The driving device 14 operates on the basis of an instruction from the controller 60 to rock the rocking member 15 around a rocking axis extending in the vertical direction.

The rocking member 15 indirectly connects the upstream roller 12 and the driving device 14. The rocking member 15 has a function of supporting the upstream roller 12 so that the upstream roller 12 positioned to be decentered from the rocking axis of the driving device 14 is rotatable. A shape of the rocking member 15 is not particularly limited as long as the function is exhibited. In this embodiment, the rocking member 15 has a quadrangular prism shape. The driving device 14 is attached to a base end of the rocking member 15. The upstream roller 12 is attached to a tip of the rocking member 15.

When the tip of the rocking member 15 is rocked by the driving device 14, the upstream roller 12 attached to the tip is also rocked to move closer to and further from the upstream roller 11. In a case where the upstream roller 12 moves closer to the upstream roller 11, the lower edge LFa of the lead frame base LF is clamped by facing peripheral surfaces of the upstream rollers 11 and 12 (see Fig. 2). That is, the conveying apparatus 1 is configured so that the pair of upstream rollers 11 and 12 can clamp the lower edge LFa of the lead frame base LF. Further, the conveying apparatus 1 is configured so that the driving device 14 can move the upstream roller 12 closer to and further from the upstream roller 11.

The downstream conveyance portion 20 includes a pair of downstream rollers 21 and 22 (first rollers), a rotary device 23 (first rotary device), a driving device 24 (first driving device), and a rocking member 25. Those configurations are similar to those of the upstream conveyance portion 10, and therefore description thereof is omitted.

As illustrated in Fig. 1, the plurality of guides 30 are arranged side by side in the conveyance direction of the lead frame base LF. In this embodiment, three guides 30 are arranged between the upstream conveyance portion 10 and the downstream conveyance portion 20. A single guide 30 is arranged on a downstream side of the downstream conveyance portion 20. At least one guide 30 may be arranged between the upstream conveyance portion 10 and the downstream conveyance portion 20. No guide 30 may be arranged on the downstream side of the downstream conveyance portion 20.

Each guide 30 includes a pair of guide rollers 31 and 32 (guide members) and a support 33. The pair of guide rollers 31 and 32 is rotatably attached to a side surface of the support 33. Both the pair of guide rollers 31 and 32 are rotatable around a rotation axis extending in the horizontal direction and in a thickness direction of the lead frame base LF. The pair of guide rollers 31 and 32 is vertically separated so that the guide roller 31 is positioned below the guide roller 32.

Both the guide rollers 31 and 32 have a cylindrical shape. Peripheral surfaces of the guide rollers 31 and 32 face each other. Grooves are provided in a circumferential direction of the peripheral surfaces of the guide rollers 31 and 32. The guide rollers 31 and 32 are configured so that those grooves guide side edges (upper edge or lower edge) of the lead frame base LF in the conveyance direction.

A shape of the grooves of the guide rollers 31 and 32 is not particularly limited. The shape of the grooves may be a V shape or may be a U shape. A separation distance between bottoms of the grooves of the guide rollers 31 and 32 may be set to be slightly larger than a width of the lead frame base LF. Specifically, the separation distance between the bottoms of the grooves of the guide rollers 31 and 32 may be set so that, when the lead frame base LF is conveyed by the conveying apparatus 1, the side

edges (upper edge or lower edge) of the lead frame base LF are positioned in the grooves but do not abut on the bottoms of the grooves.

The stopper member 40 is configured to restrain a fall of the lead frame base LF. Therefore, the stopper member 40 is arranged below the lower edge LFa of the lead frame base LF. The stopper member 40, as well as the guide rollers 31 and 32, may be a roller with a groove. In this case, when the lead frame base LF is conveyed by the conveying apparatus 1, the lower edge of the lead frame base LF may abut on a bottom of the groove.

The sensor 50 is configured to detect a height position of the upper edge of the lead frame base LF. The sensor 50 may be, for example, a laser displacement sensor. The sensor 50 transmits a detection signal regarding the height position of the upper edge to the controller 60.

For example, the controller 60 generates an instruction signal for operating each of the rotary devices 13 and 23 and each of the driving devices 14 and 24 and transmits the instruction signal to the rotary devices 13 and 23 and the driving devices 14 and 24 on the basis of a program recorded on a record medium (not illustrated), operation input from an operator, or the like.

Specifically, the controller 60 controls the rotary devices 13 and 23 and the driving devices 14 and 24 as follows. First, the controller 60 controls the driving device 24 to rock the rocking member 25. The rocking member 25 moves the downstream roller 22 closer to the downstream roller 21. With this, the pair of downstream rollers 21 and 22 clamps the lower edge LFa of the lead frame base LF. In this state, the controller 60 controls the rotary device 23 to rotate the downstream roller 21. In this way, the lower edge LFa clamped by the pair of downstream rollers 21 and 22 is sent out (first process). With this, the lead frame base LF is conveyed

downstream.

By the way, when the standing lead frame base LF is conveyed by the pair of downstream rollers 21 and 22, force pressed by the other downstream rollers 22 and 21 in a horizontal direction and frictional force applied downward in the vertical direction by the lead frame base LF slipping downward due to gravity are applied to the pair of downstream rollers 21 and 22. That is, force applied in the horizontal direction and force applied upward in the vertical direction, which serve as reaction force from the pair of downstream rollers 21 and 22, are applied to the lead frame base LF. Therefore, the lead frame base LF gradually rises from the pair of downstream rollers 21 and 22 in the conveyance process. When such a rise is ignored, the lead frame base LF finally comes off the pair of downstream rollers 21 and 22. Consequently, it may be possible that the lead frame base LF cannot be conveyed.

In view of this, the controller 60 determines whether or not a rise amount of the lead frame base LF is equal to or more than a predetermined threshold on the basis of a detection signal received from the sensor 50. When the controller 60 determines that the rise amount of the lead frame base LF is less than the threshold, the rise amount of the lead frame base LF is not so large. Therefore, the controller 60 causes the pair of downstream rollers 21 and 22 to continuously convey the lead frame base LF.

On the contrary, when the controller 60 determines that the rise amount of the lead frame base LF is equal to or more than the threshold, the rise amount of the lead frame base LF is excessively large. Therefore, the controller 60 executes a correction process of the rise. Specifically, the controller 60 further controls the driving device 14 to rock the rocking member 15 in a state in which the lead frame base LF is conveyed by the pair of downstream rollers 21 and 22. The rocking member 15 moves the upstream roller 12 closer to the upstream roller 11. With this, the pair of

upstream rollers 11 and 12 also clamps the lower edge LFa of the lead frame base LF. In this state, the controller 60 controls the rotary device 13 to rotate the upstream roller 11. The rotating upstream roller 11 sends out the lower edge LFa clamped by the pair of upstream rollers 11 and 12 (third process).

Then, the controller 60 controls the driving device 24 to rock the rocking member 25. The rocking member 25 moves the downstream roller 22 further from the downstream roller 21 (second and fourth processes). With this, the lower edge LFa of the lead frame base LF is released from the pair of downstream rollers 21 and 22. Therefore, the lead frame base LF falls in the vicinity of the pair of downstream rollers 21 and 22. The lower edge LFa of the fallen lead frame base LF is received by the stopper member 40. During this time, the lead frame base LF is conveyed by the pair of upstream rollers 11 and 12.

Then, the controller 60 controls the driving device 24 to rock the rocking member 25. The rocking member 25 moves the downstream roller 22 closer to the downstream roller 21 again. In this way, the lower edge LFa of the lead frame base LF is clamped by the pair of downstream rollers 21 and 22. The downstream roller 21 is continuously rotated by the rotary device 23. Therefore, the pair of downstream rollers 21 and 22 sends out the clamped lower edge LFa (first process).

Then, the controller 60 controls the driving device 14 to rock the rocking member 15 in a state in which the lead frame base LF is conveyed by the pair of downstream rollers 21 and 22. The rocking member 15 moves the upstream roller 12 further from the upstream roller 11 (second and fourth processes). In this way, the lower edge LFa of the lead frame base LF is released from the pair of upstream rollers 11 and 12.

The controller 60 repeats the above processes to correct the rise of the lead

frame base LF. That is, the controller 60 controls the rotary devices 13 and 23 and the driving devices 14 and 24 so that the lower edge LFa is repeatedly clamped by and released from the upstream rollers 11 and 12 and the downstream rollers 21 and 22 at predetermined intervals. More specifically, the controller 60 controls the rotary devices 13 and 23 and the driving devices 14 and 24 so that the lower edge LFa is clamped by the pair of downstream rollers 21 and 22 at least when the pair of upstream rollers 11 and 12 releases the lower edge LFa and the lower edge LFa is clamped by the pair of upstream rollers 11 and 12 at least when the pair of downstream rollers 21 and 22 releases the lower edge LFa.

A separation distance between the upstream rollers 11 and 12 and the downstream rollers 21 and 22 is not particularly limited. This separation distance may be, for example, 300 mm or more, may be 600 mm or more, or may be 800 mm or more. As the separation distance between the upstream rollers 11 and 12 and the downstream rollers 21 and 22 is shorter, the lead frame base LF is not easily fallen when the upstream rollers 11 and 12 or the downstream rollers 21 and 22 release the lower edge LFa. Therefore, an effect of correction of the rise of the lead frame base LF tends to be reduced. Note that easiness of the fall of the lead frame base LF is changeable also depending on rigidity or the like of the lead frame base LF.

Release time of the lower edge LFa from the downstream rollers 21 and 22 may be one second or less, may be 0.5 seconds or less, may be 0.3 seconds or less, or may be 0.2 seconds or less. In other words, clamp time of the lower edge LFa by the upstream rollers 11 and 12 may be at least equal to or longer than the release time of the lower edge LFa from the downstream rollers 21 and 22.

Clamp time of the lower edge LFa by the downstream rollers 21 and 22 is variously changeable depending on a degree of the rise of the lead frame base LF.

This clamp time may be, for example, approximately five seconds to seven seconds. In other words, the release time of the lower edge LFa from the upstream rollers 11 and 12 may be at least equal to or shorter than the clamp time of the lower edge LFa by the downstream rollers 21 and 22.

By the way, in a case where the lead frame base LF clamped by the upstream rollers 11 and 12 or the downstream rollers 21 and 22 is conveyed, extrusion force is applied to a portion of the lead frame base LF, the portion being positioned on a downstream side of those rollers. However, the lead frame base LF is strip-shaped sheet metal. Therefore, when the extrusion force is applied to the lead frame base LF, the lead frame base LF is very easily buckled. Accordingly, clamp time of the lower edge LFa by the downstream rollers 21 and 22 may be longer than clamp time of the lower edge LFa by the upstream rollers 11 and 12. In this case, the lead frame base LF is mainly conveyed by the downstream rollers 21 and 22. That is, the downstream rollers 21 and 22 functions as main driving rollers. In this case, a portion of the lead frame base LF, which is positioned on a downstream side of the main driving rollers, is comparatively short. This reduces an influence of extrusion force applied by the main driving rollers. Therefore, it is possible to restrain the lead frame base LF from being deformed.

[Effects]

As described above, in this embodiment, the controller 60 controls the driving device 24 so that the lower edge LFa of the lead frame base LF is clamped by the pair of downstream rollers 21 and 22. At the same time, the controller 60 controls the rotary device 23 to rotate the downstream roller 21. With this, the standing lead frame base LF is conveyed. The lead frame base LF is strip-shaped sheet metal. Therefore, bending caused by gravity is smaller on the principal surface of the standing lead frame

base than on a principal surface of a prone lead frame base. Thus, it is unnecessary to support the center of the lead frame base LF with support rollers or the like for the purpose of restraining the lead frame base LF from being bent. This restrains the lead frame base LF from being bent and deformed. Therefore, it is possible to improve processing accuracy of the lead frame base LF. In addition, when the standing lead frame base LF is conveyed, a uniform process is easily performed on both surfaces of the lead frame base LF. Further, it is unnecessary to provide a large number of support rollers for supporting the principal surface (lower surface) of the lead frame base LF, as compared to a case where the prone lead frame base LF is conveyed. This makes it possible to reduce the number of components.

In this embodiment, the driving device 24 controlled by the controller 60 intermittently moves the pair of downstream rollers 21 and 22 relatively closer to or further from each other. With this, the lower edge LFa is repeatedly clamped by and released from the pair of downstream rollers 21 and 22 at predetermined intervals. Therefore, the lower edge LFa is released from the pair of downstream rollers 21 and 22 when the lead frame base LF rises. With this, when the lead frame base LF falls by a predetermined amount, the lower edge LFa is clamped by the pair of downstream rollers 21 and 22. Thus, momentary release from the pair of downstream rollers 21 and 22 corrects the rise of the lead frame base LF. Consequently, it is possible to convey the lead frame base LF as appropriate.

In this embodiment, the lower edge LFa of the lead frame base LF is clamped by at least one pair of upstream rollers 11 and 12 and the downstream rollers 21 and 22. Therefore, even when one of the pair of upstream rollers 11 and 12 and the pair of downstream rollers 21 and 22 releases the lower edge LFa, the other pair clamps the lower edge LFa and conveys the lead frame base LF. This makes it possible to

continuously convey the lead frame base LF. In particular, when the lead frame base LF is not continuously conveyed at the time of processes such as a resist film formation process, an etching process, a plating process, an exposure process, and a resist film removal process, conveyance is temporarily stopped. Therefore, processing time becomes inconstant. This may vary a thickness of a resist film, an etching amount, a thickness of a plating film, an exposure amount, a removal amount of a resist film, and the like. However, according to this embodiment, the lead frame base LF is continuously conveyed. This makes it possible to remarkably restrain such variations.

In this embodiment, the pair of guide rollers 31 and 32 configured to guide the upper edge and lower edge of the lead frame base LF is positioned between the upstream rollers 11 and 12 and the downstream rollers 21 and 22. Therefore, the upper edge and lower edge of the lead frame base LF are guided by the guide rollers 31 and 32. Consequently, it is possible to restrain the lead frame base LF from being horizontally shaken with respect to the conveyance direction.

In this embodiment, the stopper member 40 restrains a fall of the lead frame base LF. Therefore, the lead frame base LF fallen by release from the pair of downstream rollers 21 and 22 is received by the stopper member 40. This makes it possible to restrain the lead frame base LF from being unnecessarily fallen.

[Other embodiments]

Hereinabove, the embodiment according to the present disclosure has been described in detail. However, the above embodiment may be variously modified within the gist of this embodiment. For example, the rise amount of the lead frame base LF is detected by the sensor 50 in this embodiment. However, when elapse of predetermined time is detected by a timer or the like, the lower edge LFa may be released from the downstream rollers 21 and 22.

The rotary device 13 may rotatably drive at least one of the upstream rollers 11 and 12. Similarly, the rotary device 23 may rotatably drive at least one of the downstream rollers 21 and 22.

The driving device 14 may drive at least one of the upstream rollers 11 and 12 to move the upstream rollers 11 and 12 relatively closer to or further from each other. Similarly, the driving device 24 may drive at least one of the downstream rollers 21 and 22 to move the downstream rollers 21 and 22 relatively closer to or further from each other.

The clamp time of the lower edge LFa by the upstream rollers 11 and 12 may be longer than the clamp time of the lower edge LFa by the downstream rollers 21 and 22. In this case, the lead frame base LF is mainly conveyed by the upstream rollers 11 and 12.

A period in which both the upstream rollers 11 and 12 and the downstream rollers 21 and 22 clamp the lower edge LFa may exist. That is, both the upstream rollers 11 and 12 and the downstream rollers 21 and 22 may temporarily clamp the lower edge LFa. This securely eliminates a state in which the lead frame base LF is not conveyed, i.e., a state in which the lower edge LFa is not clamped by the upstream rollers 11 and 12 or the downstream rollers 21 and 22. Therefore, it is possible to achieve continuous conveyance of the lead frame base LF more securely.

The guide 30 may include a pair of guide rails (not illustrated) extending in the conveyance direction instead of the pair of guide rollers 31 and 32. That is, the guide 30 only needs to be configured to guide the lead frame base LF in the conveyance direction.

The conveying apparatus 1 may include no guide 30. The conveying apparatus 1 may include no stopper member 40.

The conveying apparatus for a lead frame base according to the embodiment of the present disclosure may be the following first to sixth conveying apparatuses for a lead frame base.

The first conveying apparatus for a lead frame base includes: a pair of first rollers capable of clamping a lower edge of a lead frame base having a principal surface extending in a vertical direction; a first rotating mechanism configured to rotate at least one of the pair of first rollers; a first driving mechanism configured to move the pair of first rollers relatively closer to or further from each other; and a controller, in which the controller executes a first process in which the first rotating mechanism is controlled to rotate at least one of the pair of first rollers to convey the lead frame base having the lower edge clamped by the pair of first rollers and a second process in which the first driving mechanism is controlled to intermittently move the pair of first rollers relatively closer to or further from each other causing the pair of first rollers to repeatedly clamp and release the lower edge at predetermined intervals.

The second conveying apparatus for a lead frame base according to the first apparatus further includes: a pair of second rollers positioned on an upstream side of the pair of first rollers in the conveyance direction of the lead frame base and capable of clamping the lower edge of the lead frame base having the principal surface extending in the vertical direction; a second rotating mechanism configured to rotate at least one of the pair of second rollers; and a second driving mechanism configured to move the pair of second rollers relatively closer to or further from each other, in which the controller executes a third process in which the second rotating mechanism is controlled to rotate at least one of the pair of second rollers to convey the lead frame base having the lower edge clamped by the pair of second rollers and a fourth process in which the second driving mechanism is controlled to intermittently move the pair of second rollers

relatively closer to or further from each other causing the pair of second rollers to clamp the lower edge when the pair of first rollers releases the lower edge and causing the pair of second rollers to release the lower edge when the pair of first rollers clamps the lower edge.

The third conveying apparatus for a lead frame base according to the second apparatus is an apparatus in which, in the fourth process, both the pair of first rollers and the pair of second rollers temporarily clamp the lower edge.

The fourth conveying apparatus for a lead frame base according to the second or third apparatus is an apparatus in which clamp time of the lower edge by the pair of first rollers is longer than clamp time of the lower edge by the pair of second rollers.

The fifth conveying apparatus for a lead frame base according to any one of the second to fourth apparatuses further includes a pair of guide members configured to guide an upper edge and the lower edge of the lead frame base in the conveyance direction, in which the pair of guide members is arranged between the pair of first rollers and the pair of second rollers.

The sixth conveying apparatus for a lead frame base according to any one of the first to fifth apparatuses further includes a stopper member configured to restrain a fall of the lead frame base.

CLAIMS

1. A conveying apparatus for a lead frame base, comprising:
 - a pair of first rollers configured to clamp a lower edge of a lead frame base having a principal surface extending in a vertical direction;
 - a first rotary device configured to rotate at least one of the pair of first rollers;
 - a first driving device configured to move the pair of first rollers relatively closer to or further from each other; and
 - a controller configured to execute a first process and a second process, wherein
 - in the first process, the lead frame base having the lower edge clamped by the pair of first rollers is conveyed by the first rotary device controlled by the controller to rotate at least one of the pair of first rollers, and
 - in the second process, the first driving device is controlled by the controller to intermittently move the pair of first rollers relatively closer to or further from each other causing the pair of first rollers to repeatedly clamp and release the lower edge at predetermined intervals.
2. The apparatus according to claim 1, further comprising:
 - a pair of second rollers arranged on an upstream side of the pair of first rollers in a conveyance direction of the lead frame base and configured to clamp the lower edge of the lead frame base having the principal surface extending in the vertical direction;
 - a second rotary device configured to rotate at least one of the pair of second rollers; and
 - a second driving device configured to move the pair of second rollers relatively closer to or further from each other, wherein:

the controller is configured to execute a third process and a fourth process; and

in the third process, the lead frame base having the lower edge clamped by the pair of second rollers is conveyed by the second rotary device controlled by the controller to rotate at least one of the pair of second rollers, and

in the fourth process, the second driving device is controlled by the controller to intermittently move the pair of second rollers relatively closer to or further from each other causing the pair of second rollers to repeatedly clamp and release the lower edge at predetermined intervals so that the pair of second rollers clamps the lower edge at least when the pair of first rollers releases the lower edge and the pair of first rollers clamps the lower edge at least when the pair of second rollers releases the lower edge.

3. The apparatus according to claim 2, wherein
in the fourth process, the lower edge is clamped by both the pair of first rollers and the pair of second rollers.
4. The apparatus according to claim 2 or 3, wherein
clamp time of the lower edge by the pair of first rollers is longer than clamp time of the lower edge by the pair of second rollers.
5. The apparatus according to any one of claims 2 to 4, further comprising
a pair of guide members arranged between the pair of first rollers and the pair of second rollers, wherein
the pair of guide members is configured to guide an upper edge and the lower edge of the lead frame base in the conveyance direction.

6. The apparatus according to any one of claims 1 to 5, further comprising a stopper member configured to restrain a fall of the lead frame base.