

TITLE OF THE INVENTION

Lead Frame Holder

BACKGROUND OF THE INVENTION

The present invention relates to a lead frame holder, which can be employed for processing electronic components, for example, by dip-coating with protective resin.

In order to dip-coat electronic components comprising flat plate type lead terminals with protective resin, a holder called a separator is employed. This holder is adapted to hold lead frames, to which electronic component elements are mounted, for example, by soldering, in a parallel and flush manner. The holder thus holding lead frames is inverted to dip the electronic component elements in a dip-coating vessel, thereby forming protective resin layers around the electronic component elements. Thereafter the holder holding the lead frames is carried toward a heat treating furnace, to dry and bake the protective resin-layers. Then the lead frames are removed from the holder and carried to a subsequent step.

Fig. 5 shows a conventional holder B. This holder B comprises a rectangular frame 50 and two guide shafts 51 which are fixed in the frame 50 in parallel with each other, so that the guide shafts 51 pass through a number of holding plates 52 in a slidable manner, as well as both end portions of a bent plate spring 53. Strip portions of lead

frames 54 are inserted between the respective holding plates 52 under pressure. While Fig. 5 illustrates only two lead frames 54, such lead frames 54 are inserted between the respective pairs of holding plates 52 before the plate spring 53 is interposed between an endmost holding plate 52a and the inner surface of the frame 50 in a pressed and deformed state, so that the lead frames 54 are held between the holding plates 52 under pressure. Though Fig. 5 illustrates only two lead frames 54, such lead frames 54 are held between the respective pairs of holding plates 52 in practice.

In order to hold the lead frames 54 by the above holder B, it is necessary to turn the plate spring 53 upwardly on the guide shafts 51 so as to cancel the pressing force against the holding plates 52, and to slide the holding plates 52 along the guide shafts 51, thereby making gaps between the respective pairs of holding plates 52. Then, each lead frame 54 must be inserted in each gap between the holding plates 52 one by one from above, and the plate spring 53 must be turned back to be brought into pressure contact with the endmost holding plate 52a and the frame 50. In order to take out the lead frames 54 from the holder B, on the other hand, the pressing force against the holding plates 52 is canceled in the same way as above, so that the lead frames 54 are taken out from the gaps. All

such operations must be carried out by hand, leading to inferior workability and difficulty in automation.

When the lead frames 54 are inserted between the holding plates 52, lower edges of the strip portions thereof touch the guide shafts 51, to stop there. At this time, the center portions of the lead frames 54 may be downwardly bent or the lower edges of the strip portions may not reliably touch the guide shafts 51. Thus, electronic component elements 55, which are mounted on the lead frames 54, may not be flush with each other. Consequently, positions coated with the protective resin are varied. Such a problem is significant particularly in relation to electronic components with short lead terminals.

SUMMARY OF THE INVENTION

In a first aspect, the invention provides a lead frame holder for holding a plurality of elongate lead frames, to which electronic component elements are mounted, in parallel with each other, said holder comprising:

- a substrate;

- a plurality of parallel receiving grooves provided on a surface of said substrate, each groove being open at least at one end and being capable of receiving slidably therein a strip portion of a said lead frame; and

a permanent magnet fixed to said substrate for attracting said lead frames to said receiving grooves by magnetic force.

Elongate lead frames to which electronic component elements are mounted can be sidewardly inserted in the receiving grooves provided in the substrate. In order to prevent the lead frames from displacement or decrease inclination of them, the depths of the receiving grooves are preferably made substantially equal to or slightly larger than the widths of strip portions of the lead frames. Further, the widths of said receiving grooves are preferably made slightly larger than thickness of strip portions of said lead frames in order to decrease inclination of said lead frames while allowing slidability of said lead frames.

The strip portion of the lead frames are attracted and held by magnetic force of the permanent magnet, which is fixed in proximity to the receiving grooves. In a preferred embodiment, the attraction of the permanent magnet is so set that the lead frames will not drop from the receiving grooves when the holder is inverted for dip coating.

It is possible to take out the lead frames from the holder by simply drawing them out sidewardly from the holder through sideward openings of the receiving

grooves. Since the lead frames can be sidewardly inserted in and taken out from the holder, automation is enabled and workability is remarkably improved as compared with the conventional operations for manually inserting and taking out the lead frames. In order to smoothly guide the lead frames which are inserted in the receiving grooves of the holder, one side of the openings of the receiving grooves are preferably formed in a divergent manner.

The inventive holder does not require any means for setting a plate spring as is required in the prior art discussed above, and therefore it is possible to enlarge the space for holding the lead frames, thereby increasing the number of lead frames which can be held in a single holder. Thus, dip coating efficiency can be improved.

When the substrate is formed of a non-magnetic material and the permanent magnet is fixed on its lower surface close to the bottoms of the receiving grooves, the lower edges of the lead frames are brought into close contact with only bottoms of the receiving grooves, so that the contact areas between the lead frames and the substrate are reduced, whereby the lead frames can be easily taken out from the receiving grooves. Since the lower edges of the lead frames are thus brought into close contact with the

bottoms of the receiving grooves, bending of the lead frames can be prevented to reduce height variation of the electronic component elements. Thus, it is also possible to reduce variation of positions to be coated with protective resin, whereby the present invention can be easily applied to electronic components with short lead terminals, dissimilarly to the prior art.

When a groove for fixing the permanent magnet is formed in the lower surface of the substrate, the permanent magnet can easily be fixed on the substrate in such a way that it does not contact with the lead frames, whereby the magnet is protected against the lead frames.

While the substrate can be prepared from a single large-sized plate, it is preferably formed by a plurality of substrate members which are coupled in parallel with each other, so that the receiving grooves can be easily worked and warping of the substrate members due to working can be suppressed, and the holder can be reduced in weight.

In a second aspect, the invention provides a method of forming dipped electronic components comprising:

sidewardly inserting a lead frame having protruding lead terminals fixed to electronic components, into one of a plurality of receiving

grooves of a magnetic lead frame holder such that the lead frame is accurately held in position by a magnetic force;

moving the lead frame holder by one receiving groove such that another lead frame can now be inserted into an empty receiving groove;

repeating the above steps until lead frames are inserted into all the receiving grooves;

dip coating and heat treatment said electronic components to form a protective layer on said components; and

sidewardly drawing out each of said lead frames from said lead frame holder, for further processing.

In a third aspect, the invention provides a method of securely holding electronic components,

the method including inserting a plurality of lead frames having protruding terminal leads fixed to electronic components into receiving grooves of a magnetic lead frame holder such that the lead frames are slidably retained in the receiving grooves by a magnetic force.

In a fourth aspect, the invention provides a lead frame holder for holding a plurality of lead frames to which electronic components are mounted comprising magnetic receiving grooves for slidably retaining the lead frames therein a magnetic force.

With reference to the preferred embodiment, the invention enables a lead frame holder to be provided in which lead frames can easily be retained, and discharged. The invention also enables a lead frame holder to be provided which can prevent bending of lead frames and reduce height variation of electronic component elements.

The above and further features of the present invention are set forth with particularity in the claims and should become clearer from consideration of the following detailed description of an exemplary embodiment of the present invention given with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing a holder according to the present invention, in a state for receiving a lead frame;

Fig. 2 is an enlarged sectional view taken along the line II - II in Fig. 1;

Fig. 3 is a sectional view taken along the line III - III, showing a state of a dip coating step;

Fig. 4 is a sectional view taken along the line IV - IV in Fig. 3; and

Fig. 5 is a perspective view showing a conventional holder.

DESCRIPTION OF THE EMBODIMENT

Fig. 1 shows a holder A according to an embodiment of the present invention, which is formed by four rectangular substrate members 1 and a pair of guide plates 10 having inverse T-shaped sections. Each substrate member 1, which is made of a non-magnetic metal such as aluminum, is provided on its upper surface in a shorter edge direction with a number of parallel receiving grooves 2 opening on both side portions. The depth of each receiving groove 2 is substantially equal to the cross-directional size of a strip portion 21 of a lead frame 20. A first opening 3 of each receiving groove 2 is so tapered that an inclined surface 4, which is gradually downwardly inclined toward the opening 3, is formed in a groove bottom portion close to the opening 3. The opening 3 and the inclined surface 4 are adapted to smoothly guide an end portion of the lead frame 20, which is sidewardly inserted in the holder A. On the

other hand, a substantially T-shaped groove 5 is longitudinally continuously formed in the lower surface of each substrate member 1, so that a pole-type permanent magnet 6 having a rectangular section is embedded in and fixed to this groove 5. Thus, magnetic force of the permanent magnet 6 acts on the strip portion 21 of each lead frame 20 inserted in each receiving groove 2, to attract and hold the strip portion 21 along the direction of the receiving groove 2.

Both end portions of each substrate member 1 are placed on stepped faces 11 of the guide plates 10 and fixed thereto by screws 12, so that the four substrate members 1 are coupled with each other and fixed to the guide plates 10 in a parallel manner. Since four substrate members 1 have the same structure, the receiving grooves 2 of the substrate members 1 are aligned with each other. Horizontal portions 13 of the guide plates 10 are held by a driving mechanism (not shown), to support the holder A for receiving and discharging lead frames 20, and for other processes such as dip-coating them, and carrying them to a heat treating furnace.

Each lead frame 20, which is press-worked from a plate of a magnetic metal such as Fe, comprises the continuous strip portion 21 and triplets of lead terminals 22 upwardly projecting from the strip portion 21 in parallel with each other. The strip portion 21 is provided with pilot holes 23

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at regular intervals. An electronic component element 24 is connected and fixed to each triplet of the lead terminals 22, for example, by soldering.

A method of using the holder A is now described.

First, the receiving grooves 2 of the holder A are set upwardly. Then, pawls 30 (see Fig. 2) of an introducing and discharging mechanism are inserted between the respective triplets of the lead terminals 22 of the lead frames 20 in a preceding step, and the lead frames 20 are sidewardly inserted one by one in the receiving grooves 2 of the holder A. At this time, the forward ends of the strip portions 21 are guided into the receiving grooves 2 by the openings 3 and the inclined surfaces 4, so that the lead frames are smoothly guided even if they are slightly misaligned with grooves 2 in the horizontal or vertical direction, and the strip portions 21 are not deformed. When a first lead frame 20 is completely inserted in first grooves 2, the holder A is moved by one pitch in a direction perpendicular to the receiving grooves 2, to receive a second lead frame 20 in second grooves 2. Such an operation is repeated until the lead frames 20 are inserted in all receiving grooves 2. The lead frames 20 thus inserted in the receiving grooves 2 of the substrate members 1 are attracted and held by the permanent magnets 6 which are embedded in proximity to the bottom portions of

the receiving grooves 2, so that the lower edges of the strip portions 21 are in close contact with the bottoms of the receiving grooves 2. Thus, it is possible to prevent bending of the lead frames 20, thereby reducing variation in heights H of the electronic component elements 24 in relation to the substrates 1 (see Fig. 2). In more specific terms, it is possible to reduce such variation of the heights H, which has been about 1.2 mm in the conventional holder (see Fig. 5), to 0.2 mm according to the present invention. Then, the holder A is inverted for dip coating. Also at this time, the lead frames 20 will not drop from the receiving grooves 2, due to attraction of the permanent magnets 6. After the lead frames 20 are inverted, the electronic component elements 24 are dipped in a protective resin solution 40, as shown in Figs. 3 and 4. In this case, variation in coating of the protective resin solution 40 is reduced due to the small variation in heights H of the electronic component elements 24, whereby it is possible to obtain electronic components of uniform quality. After the dip coating step, the holder A is again inverted to upwardly direct the lead frames 20, and carried into a heat treating furnace (not shown), so that layers of the protective resin solution 40 applied toward the peripheries of the electronic component elements 24 are dried and solidified therein. After the layers of the

protective resin solution 40 are solidified, the pawls 30 (see Fig. 2) of the introducing and discharging mechanism are again inserted between the triplets of the lead terminals 22, and the lead frames 20 are sidewardly drawn out in a horizontal manner, to be carried to a subsequent step.

The present invention is not restricted to the above embodiment, but various modifications are available within the scope of the present invention, as a matter of course.

For example, the four substrate members 1 are coupled in parallel by the pair of guide plates 10 in the above embodiment in order to suppress warp of the substrate members 1 due to working of the receiving grooves 2 as well as to reduce the weight of the holder A. Alternatively, receiving grooves may be formed on the upper surface of a single large-sized substrate. In this case, it is possible to form stepped portions on both sides of the substrate, thereby omitting the guide plates.

The permanent magnets may be fixed at least in proximity to the receiving grooves. It is not requisite to employ the pole-type permanent magnets which extend along the overall lengths of the substrate members as shown in the aforementioned embodiment.

The non-magnetic material for the substrate is not restricted to a metal such as aluminum, but a resin material

may also be employed.

The receiving grooves may not open on both sides, but the openings may be provided only on first sides. When the receiving grooves have openings on both sides, however, the lead frames can advantageously be inserted and taken out in two directions.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the scope of the present invention being limited only by the terms of the appended claims.



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CLAIMS:

1. A lead frame holder for holding a plurality of elongate lead frames, to which electronic component elements are mounted, in parallel with each other, said holder comprising:

a substrate;

a plurality of parallel receiving grooves provided on a surface of said substrate, each groove being open at least at one end and being capable of receiving slidably therein a strip portion of a said lead frame; and

a permanent magnet fixed to said substrate for attracting said lead frames to said receiving grooves by magnetic force.

2. A lead frame holder in accordance with claim 1, wherein

said substrate is formed of a non-magnetic material, and said permanent magnet is fixed proximate the bottoms of said receiving grooves.

3. A lead frame holder in accordance with claim 1 or 2, wherein

said substrate is formed by a plurality of rectangular plates each having a plurality of



transverse parallel grooves, and both end portions of said substrate members are coupled in parallel with each other by guide plates so that said receiving grooves are aligned with each other.

5 4. A lead frame holder in accordance with claim 3, wherein

 magnet fixing grooves are formed longitudinally along the lower surfaces of said substrate members and said permanent magnets are inserted in and fixed to
10 said fixing grooves.

 5. A lead frame holder in accordance with any preceding claim wherein

 an opening formed at one end of each receiving groove opens in a divergent manner.

15 6. A lead frame holder in accordance with any preceding claim wherein the depths of said receiving grooves are made substantially equal to the widths of said strip portions of said lead frames.

 7. A lead frame holder in accordance with any
20 preceding claim wherein

 the widths of said receiving grooves are made slightly larger than the thickness of said strip



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portions of said lead frames in order to restrict inclination of said lead frames while allowing slidability of said lead frames.

5 8. A method of forming dipped electronic components comprising:

sidewardly inserting a lead frame having protruding lead terminals fixed to electronic components, into one of a plurality of receiving grooves of a magnetic lead frame holder such that the
10 lead frame is accurately held in position by a magnetic force;

moving the lead frame holder by one receiving groove such that another lead frame can now be inserted into an empty receiving groove;

15 repeating the above steps until lead frames are inserted into all the receiving grooves;

dip coating and heat treatment said electronic components to form a protective layer on said components; and

20 sidewardly drawing out each of said lead frames from said lead frame holder, for further processing.

9. A method of securely holding electronic components,

the method including inserting a plurality of



lead frames having protruding terminal leads fixed to electronic components into receiving grooves of a magnetic lead frame holder such that the lead frames are slidably retained in the receiving grooves by a magnetic force.

10. A lead frame holder for holding a plurality of lead frames to which electronic components are mounted comprising magnetic receiving grooves for slidably retaining the lead frames therein by a magnetic force.

11. A method or holder substantially as herein described with reference to the accompanying drawings.