DESCRIPTION

MOUNTING DEVICE FOR ELECTRICAL COMPONENT

Technical Field

The present invention relates to techniques for mounting electrical components, for example, semiconductor chips or the like on a wiring board, and particularly, to techniques for mounting electrical components using an adhesive agent.

Background Art

Conventionally, a method using an anisotropic conductive adhesive film in which conductive particles are dispersed in a binder is known for directly mounting a bear chip on a wiring board such as a printed wiring board.

In the mounting method using the anisotropic conductive adhesive film, after an IC chip is placed on a board to which the anisotropic conductive adhesive film adheres, pressure/heat is applied to the IC chip by a flat ceramic, metal or other pressure bonding head to cure the anisotropic conductive adhesive film. This is know as mounting by thermocompression bonding.

One problem associated with such a method that involves applying pressure/heat using a metal or other pressure bonding head is that a fillet portion of an adhesive agent around the

IC chip does not become heated sufficiently heated during the thermocompression bonding, thereby reducing connection reliability. Another problem associated with such a method that it is difficult to mount a plurality of IC chips.

Consequently, in order to solve these problems, techniques have been proposed in recent years that perform thermocompression bonding of IC chips using a thermocompression bonding head made of an elastic body such as silicone rubber (for example, see Patent Documents 1 and 2).

However, these conventional techniques have a problem that sufficient connection the IC chip and the board cannot be achieved because a sufficient pressurizing force is not applied to a portion between bumps and patterns. As a result, the initial conduction resistance and the connection reliability after aging cannot be sufficiently secured.

Another disadvantage of a method that involves applying pressure/heat using a thermocompression bonding head made of an elastic body is that displacement occurs between the IC chip and the board during pressure bonding.

The extent of the displacement tends to increase particularly in the case when a plurality of IC chips are mounted at one time.

Patent document 1: JP 2000-79611A

Patent document 2: JP 2002-359264A

Disclosure of the Invention

Problems to be Solved by the Invention

The present invention has been achieved to solve such problems of conventional techniques, and it is an object of the present invention to provide a mounting device that can mount a plurality of electrical components with an adhesive agent in a highly reliable manner.

Means for Solving Problems

The present invention for achieving the above-described purpose provides a mounting device for an electric component that includes a thermocompression bonding head that includes a pressure bonding member made of a predetermined elastomer that is provided in a head main body, and a pressing force adjusting mechanism for adjusting a pressing force corresponding to a region on a pressure bonding surface of the pressure bonding member, wherein the pressure bonding member is pressed at a predetermined pressure towards an electric component placed on a wiring board.

The present invention provides the mounting device described above, wherein a plurality of frame-shaped pressing force adjusting portions are provided in the head main body as the pressing force adjusting mechanism, and the pressure bonding member is disposed inside the pressing force adjusting portions.

The present invention provides the mounting device

described above, wherein a pressing force adjusting portion in the form of a protrusion is provided in the head main body as the pressing force adjusting mechanism.

The present invention provides the mounting device described above, wherein the heights of the pressing force adjusting portions are differentiated.

The present invention provides the mounting device described above, wherein the pressing force adjusting mechanism is buried in the pressure bonding member.

The present invention provides the mounting device described above, wherein the pressing force adjusting mechanism includes a cut portion in the pressure bonding member.

The present invention provides the mounting device described above, wherein the pressing force adjusting mechanism comprises a plurality of the pressure bonding members integrally connected.

The present invention provides the mounting device described above that includes a base for supporting the wiring board, and a heater provided in the base.

In the present invention, when an electrical component is pressed by a pressure bonding member made of a predetermined elastomer during thermocompression bonding, while a region on the pressed side of the electrical component (for example, a top region opposing the pressure bonding member) is pressed at a predetermined pressure toward the wiring board, a region on

the lateral sides of the electrical component is pressed at a smaller pressure than the pressure applied to the region on the pressed side.

As a result, while sufficient pressure can be applied to a connection portion of the electrical component and the wiring board, pressure can be applied to a fillet portion around the electrical component so as to prevent generation of voids. Accordingly, connection of IC chips, etc. can be performed in a highly reliable manner using an anisotropic conductive adhesive film, for example.

In addition, in the present invention, a pressing force adjusting mechanism for adjusting the pressing force for each of various regions on a pressure bonding surface of the pressure bonding member is provided, and such that when pressing a plurality of electrical components simultaneously with respective pressure bonding portions, it is possible to press regions on the pressed side and the lateral sides of each electrical component respectively with an optimal force. This result in highly reliable mounting and avoids displacement between each electrical component and the board during the pressure bonding.

Specifically, in the present invention, a plurality of frame-shaped pressing force adjusting portions as the pressing force adjusting mechanism are provided in the head main body. When the pressure bonding member is arranged inside these

pressing force adjusting frame portions, it becomes possible to achieve without fail a condition with respect to a corresponding electrical component that regions on the lateral sides of an electrical component are pressed with a smaller pressure than regions on the pressed side of the electrical component. In addition, since fine adjustment of the materials, hardness degree, and other properties of the pressure bonding member in the pressing force adjusting frame portions is possbile, displacement can be reliably prevented when a large number of electrical components are mounted at simultaneously.

Furthermore in the present invention, if a pressing force adjusting portion in the form of protrusion is provided in the head main body as the pressing force adjusting mechanism, and/or the pressing force adjusting portions are configured such that the heights of the pressing force adjusting portions are differentiated, the pressing force applied to each of various regions on the pressure bonding surface of the pressure bonding member can be optimazed. Consequently it is possible to perform more reliable thermocompression bonding for a plurality of electrical components simultaneously by avoiding positional displacement of the electrical components.

In the present invention, a construction is adopted in which the pressing force adjusting mechanism is buried in the pressure bonding member and pressure bonding can be performed even when the electrical component is located directly below

the pressing force adjusting mechanism. Consequently, smooth pressing can be performed in various regions on the pressure bonding surface. As a result, it is not necessary to prepare the thermocompression bonding head based on the number, allocation position, size or the like of the electrical component, and thermocompression bonding can be performed for a plurality of electrical components of various types simultaneously, without the disadvantage of positional displacement of the various electrical components.

Further, in the present invention, a cut portion is provided in the pressure bonding member as the pressing force adjusting mechanism such that only the portion of the pressure bonding member contacting the electrical component is compressed without the pressing force being transmitted to adjacent portions beyond the cut portion. Consequently, it becomes possible to prevent positional displacement of the electrical component by a simple method without forming a frame portion.

Furthermore, in the present invention, when the pressing force adjusting mechanism comprises a plurality of pressure bonding members integrally formed, the gap similar to the cut portion described above can be formed in the pressure bonding member, so as to prevent positional displacement of the electrical component by a simple method without use of a frame portion.

Effects of the Invention

According to the present invention, a plurality of electrical components can be mounted with an adhesive agent with a high degree of reliability.

Brief Description of the Drawings

Fig. 1(a) is a schematic construction diagram showing major portions of a mounting device of the present embodiment.

Fig. 1(b) is an explanatory diagram illustrating the positional relationship between a thermocompression bonding head of a mounting device and IC chips.

Figs. 2(a) and 2(b) are processing diagrams illustrating an example of a mounting method using the mounting device of the present embodiment.

Fig. 3 is a schematic construction diagram showing another embodiment of the present invention.

Fig. 4 is a schematic construction diagram showing yet another embodiment of the present invention.

Fig. 5 is a schematic construction diagram showing still another embodiment of the present invention.

Fig. 6 is a schematic construction diagram showing still another embodiment of the present invention.

Fig. 7(a) is a plan view showing a head main body of still another embodiment of the present invention.

Fig. 7(b) is a cross-sectional view taken along the line A-A in Fig. 7(a).

Description of Reference Numerals

1 mounting device

2 base

3 heater

4 thermocompression bonding head

5 head main body

5a pressing force adjusting frame (frame-shaped pressing force adjusting portion, pressing force adjusting mechanism)

6 pressure bonding member

6a pressure bonding surface

7 anisotropic conductive adhesive film

7c fillet portion

10 wiring board

20 IC chip (electrical component)

20a top portion

Best Mode for Carrying Out the Invention

In the following, embodiments of a mounting device for electrical components according to the present invention are described in detail through reference to the drawings.

Fig. 1(a) is a schematic construction diagram showing

major portions of a mounting device of the present embodiment, and Fig. 1(b) is an explanatory diagram illustrating the positional relationship between a thermocompression bonding head of the mounting device and IC chips.

As shown in Figs. 1(a) and 1(b) in accordance with an embodiment of the invention, a mounting device 1 includes a base 2 that holds a wiring board 10 on which a wiring pattern 10a is formed, and a thermocompression bonding head 4 for applying pressure and heat to an IC chip (electrical component) 20 having a bump 20b.

The base 2 is made of a predetermined metal and a heater 3 for heating is provided inside the base 2.

The thermocompression bonding head 4 includes a head main body 5 made of a predetermined metal, and a heater (not shown) for heating is provided inside thereof.

At a portion of the head main body 5 opposing the base 2, a plurality of pressing force adjusting frames (pressing force adjusting mechanism) 5a are provided so as to correspond to a plurality of IC chips 20. Concave portions 5b are provided that are divided into plural spaces by the pressing force adjusting frames 5a.

In the present embodiment, a pressure bonding members 6 made of a plate-shaped elastomer is attached to the inner wall of each of the concave portions 5b.

The pressure bonding member 6 of the present embodiment

is disposed such that a flat pressure bonding surface 6a is in a substantially horizontal position. The pressure bonding surface 6a of the pressure bonding member 6 is configured to have a larger area than the area of a top portion 20a of the IC chip 20 so as to apply uniform force to the top portion 20a.

It is preferable that the thickness of the pressure bonding member 6 is equal to or larger than the thickness of the IC chip 20 in order to apply an optimal pressure to the top portion 20a and a fillet portion 7c (described later) on the lateral sides of the IC chip 20.

The type of elastomer used for the pressure bonding member 6 of the present invention is not limited. However, it is preferable to use an elastomer whose rubber hardness degree is not less than 40 and not more than 80 to improve connection reliability.

Elastomers having a rubber hardness degree of less than 40 do not apply sufficient pressure to the IC chip 20. A a result, the initial resistance and connection reliability become poor. If the pressure bonding member is made from an elastomer with a rubber hardness degree of more than 80, insufficient pressure is applied to the fillet portion. This generates voids in a binder resin of an adhesive agent, thereby making the connection reliability poor.

In the present specification, the rubber hardness degree is taken according to JIS S 6050 (room temperature as

temperature condition: 5 to 35℃).

The method used for measuring the rubber hardness degree according to JIS S 6050 is described as follows:

Using a spring hardness testing machine whose pressing needle has a hemispheric shape with a diameter of 5.08 ± 0.02 mm, a pressing surface of the pressing needle is brought into contact with a surface of a horizontally-retained test piece, with the pressing needle of the testing machine being kept vertical to the surface of the test piece, and a gauge is immediately read in a positive number.

The entire surface of the test piece is equally divided into three areas, and measurement is performed at a single spot in the central portion for each area. The median value of the measured values is taken as the hardness of the test piece.

Note 1: The height of the pressing needle is 2.54 ± 0.02 mm when the gauge indicates "0," and 0 mm when the gauge indicates "100."

Note 2: the relation between the gauge and the spring force (N) is as follows: the spring force (N) is 0.54 when the gauge indicates "0," 1.32 when the gauge indicates "10," 2.11 when the gauge indicates "20," 2.50 when the gauge indicates "25," 2.89 when the gauge indicates "30," 3.68 when the gauge indicates "40," 4.46 when the gauge indicates "50," 5.25 when the gauge indicates "60," 6.03 when the gauge indicates "70," 6.42 when the gauge indicates "75," 6.82 when the gauge

indicates "80," 7.60 when the gauge indicates "90," and 8.39 when the gauge indicates "100."

During experimentation, the inventors confirmed that when the pressure bonding member 6 was heated from room temperature to 240℃, the rubber hardness degree of the elastomer of the pressure bonding member 6 showed very little change (approximately ± 2).

Both natural rubber and synthetic rubber can be used as the above elastomer. It is preferable to use silicone rubber for its heat resistance and pressure resistance properties.

Figs. 2(a) and 2(b) are processing diagrams illustrating an example of a mounting method using a mounting device of the present embodiment.

In order to mount the IC chip 20 in the present embodiment, refereeing to Fig. 2(a), the wiring board 10 is disposed on the base 2, and an anisotropic conductive adhesive film 7 is placed on the wiring board 10. The anisotropic conductive adhesive film 7 is formed by dispersing conductive particles 7b in binder resin 7a.

It should be noted that if the amount of the conductive particles 7b dispersed in the binder resin 7a is small, the melt viscosity of the adhesive film 7 when used as the adhesive agent in the present invention is not affected by the presence/absence of the dispersed conductive particles 7b.

The IC chip 20 is placed on this anisotropic conductive

adhesive film 7 and the pressure bonding surface 6a of the thermocompression bonding head 4 is pressed against the top portion 20a of the IC chip 20 via a protective film (not shown) to perform temporary pressure bonding under predetermined conditions. Further, pressure bonding is performed under the conditions described below.

To reliably prevent the generation of voids by sufficiently heating the fillet portion 7c around the IC chip 20, it is preferable that the IC chip 20 side is heated at a predetermined temperature and the wiring board 10 side is heated at a temperature higher than the above predetermined temperature, during the pressure bonding.

Specifically, the heater of the thermocompression bonding head 4 is controlled such that the temperature of the pressure bonding member 6 is set to approximately 100℃, and the heater 3 of the base 2 is controlled such that the temperature of the binder resin 7a of the anisotropic conductive adhesive film 7 is set to approximately 200℃.

In this way, during the thermocompression bonding, the anisotropic conductive adhesive film 7 is heated so that its melt viscosity is not less than 1.0×10^{2} mPa・s and not more than 1.0×10^{5} mPa・s.

If the melt viscosity of the anisotropic conductive adhesive film 7 during thermocompression bonding is less than 1.0×10^{2} mPa・s, there is a drawback that the fluidity of the

binder resin 7a during thermocompression bonding is large, generating voids and making the initial resistance and the connection reliability poor. If the melt viscosity of the anisotropic conductive adhesive film 7 is more than 1.0×10^5 m Pa·s, there is a drawback that the binder resin 7a cannot fully be eliminated at the connecting portion during thermocompression bonding, thereby generating voids and making the initial resistance and the connection reliability poor.

During the thermocompression bonding, the pressure applied to each IC chip 20 is approximately 100 N for about 15 seconds.

As shown in Fig. 2(b), in the present embodiment, while the top portion 20a of the IC chip 20 is pressed toward the wiring board 10 with a predetermined pressure by pressurizing the pressure bonding member 6 made of the above-described elastomer, the fillet portions 7c at the lateral sides of the IC chip 20 also can be pressed with a pressure that is smaller than the pressure applied to the top portion 20a. Accordingly, a sufficient pressure can be applied to the connecting portion of the IC chip 20 and the wiring board 10, and to the fillet portion 7c around the IC chip 20 such that no voids are generated.

As a result, according to the present embodiment, high reliable connection of the IC chip 20 or the like can be obtained using the anisotropic conductive adhesive film 7.

Furthermore, in the present embodiment, the pressing force of each pressure bonding member 6 is adjusted by the pressing force adjusting frames 5a, such that the top portion 20a and the lateral sides of each IC chip can be pressed with an optimal pressure (particularly, uniform force to the lateral sides of the IC chip 20), when a plurality of IC chips 20 are pressed by the respective pressure bonding members 6 at a time. As a result, in this embodiment, it is possible to prevent displacement between each IC chip 20 and the board 10 during pressure bonding, thereby making the mounting highly reliable.

Figs. 3-6 are schematic construction diagrams illustrating other embodiments of the present invention. Elements described in references to Figs. 1(a)-2(b) are assigned with the same reference numerals, and detailed description thereof is omitted.

In a mounting apparatus 1A in accordance with an embodiment of the invention shown in Fig. 3, the head main body 5 includes a plurality of pressing force adjusting frames 5a provided in the concave portion 5b of the head main body 5. In this embodiment, a construction is adopted in which these pressing force adjusting frames 5a are buried inside the pressure bonding member 6 that is integrally formed inside the concave portion 5b.

In addition, positioned between the pressing force adjusting frames 5a are pressing force adjusting frames 50

having shorter lengths than the length of the pressing force adjusting frames 5a, and the lengths of pressing force adjusting frames 50 are differentiated.

In the present embodiment, by changing the position and the length of the pressing force adjusting frames 5a and 50, the pressing force can be adjusted for various regions on the pressure bonding surface 6a of the pressure bonding member 6.

With the present embodiment configured as described above, because it is possible to perform pressure bonding even when the IC chip 20 and the wiring board 10 are directly below the pressing force adjusting frame 5a, smooth pressing can be performed in various regions on the pressure bonding surface 6a. As a result, it is not required to prepare the thermocompression bonding heads 4 based on the number, allocation position, size or the like of the IC chip 20, and thermocompression bonding can be performed for a plurality of IC chips 20 simultaneously while preventing positional displacement of the IC chips 20.

Other construction and effects are the same as the above-described embodiment, and detailed description thereof is omitted.

In a mounting device 1B shown in Fig. 4, a cut portion 6b is provided as a pressing force adjusting mechanism at the pressure bonding surface 6a of the pressure bonding member 6 that is attached inside the concave portion 5b of the head main

body 5.

In this embodiment, a plurality of the cut portions 6b are provided at predetermined intervals. By changing the number, orientation and depth of the cut portions 6b, the pressing force can be adjusted corresponding to each of various regions on the pressure bonding surface 6a of the pressure bonding member 6.

With the present embodiment configured as described above, for example, when the IC chip 20 is pressed by a portion of the pressure bonding surface 6a other than the cut portion 6b, only the direct pressing portion of the pressure bonding surface 6a can be compressed without the pressing force being transmitted to adjacent portions of pressure bonding surface 6a beyond the cut portion 6b. Consequently, it is possible to prevent positional displacement of the IC chip 20 by a simple method without the need to form the frame portion.

It should be noted that the gap formed in the cut portion 6b is narrow. Therefore, even when the IC chip 20 is placed directly below the cut portion 6b, the IC chip 20 is not displaced during thermocompression bonding and smooth pressing can be performed at each of various regions on the pressure bonding surface 6a.

Advantage of the present embodiment configured as described above, it is not necessary to prepare the thermocompression bonding heads 4 based on the number,

allocation position, size or the like of the IC chip 20. A further advantage is that thermocompression bonding can be performed for a plurality of IC chips 20 simultaneously without positional displacement of the IC chips 20.

Other construction and effects are the same as the above-described embodiment, and detailed description thereof is omitted.

A mounting device 1C in accordance with an embodiment of the invention is shown in Fig. 5 and combines features of the embodiment shown in Fig. 3 and the embodiment shown in Fig. 4.

In the present embodiment, the pressing force adjusting frames 5a and 50 are buried inside the pressure bonding member 6 provided in the concave portion 5b of the head main body 5. Cut portions 6b are provided in the pressure bonding surface 6a of the pressure bonding member 6.

With the present embodiment configured as described above, it is not required to prepare the thermocompression bonding head 4 based on the number, allocation position, size or the like of the IC chip 20, and thermocompression bonding can be performed for a plurality of IC chips 20 simultaneously while avoiding positional displacement of the IC chips 20.

Especially in the present embodiment, since a construction is adopted in which the pressing force adjusting frames 5a and 50 of the head main body 5 and the cut portions 6b of the pressure bonding member 6 are used jointly to form

the pressing force adjusting mechanism, it is possible to finely adjust the pressing force applied by various regions on the pressure bonding surface 6a of the pressure bonding member 6.

Other structure and effects are the same as the above-described embodiment, and detailed description thereof is omitted.

A mounting device 1D shown in Fig. 6 is configured such that the pressing force adjusting frames 5a are buried inside the pressure bonding member 6 provided in the concave portion 5b of the head main body 5. A plurality of (two types in the present embodiment) pressure bonding members 61 and 62 are made to form an integrated construction.

As shown in Fig. 6, in the present embodiment, a construction is adopted in which a rectangular parallelepiped-shaped concave portion, for example, is formed in the first pressure bonding member 61 of the concave portion 5b of the head main body 5, and the second pressure bonding member 62 having the same shape as the concave portion formed in the first pressure bonding member 61 is fitted into the concave portion, thereby forming the flat pressure bonding surface 6a.

In this embodiment, the second pressure bonding member 62 is penetrated by the pressing force adjusting frames 5a of the head main body 5 to be supported by the same, and fixed with an adhesive agent, for example, to an interface 61a of the first

pressure bonding member 61 on the side of the concave portion 5a of the head main body 5.

A gap 60 is formed between a lateral side surface of the second pressure bonding member 62 and the lateral surface of the first pressure bonding member 61.

According to the present embodiment configured as described above, since the gap 60 as similar to the cut portion 6b is formed between the first and second pressure bonding members 61 and 62, it is possible to prevent positional displacement of the IC chip 20 by a simple method without the need for a frame portion.

In this embodiment, same as in the above embodiment, the gap 60 is narrow such that even when the IC chip 20 is placed directly below the gap 60, the IC chip 20 is not displaced during thermocompression bonding.

From the viewpoint of reliably achieving the effect of the present invention and improving connection reliability, it is preferable to make the second pressure bonding member 62 from a material whose rubber hardness degree is lower than that of the first pressure bonding member 61.

According to the present embodiment configured as described above, it is not required to prepare the thermocompression bonding head 4 based on the number, allocation position, size or the like of the IC chip 20, and thermocompression bonding can be performed for a plurality of

IC chips 20 simultaneously without positional displacement of the IC chips 20.

Other construction and effects are the same as the above-described embodiment so that detailed description thereof is omitted.

The invention is not limited to the above-described embodiments, and various modifications are possible.

For example, in the above-described embodiments, frame-shaped pressing force adjusting portions are provided as the pressing force adjusting mechanism in the head main body. However, the present invention is not limited to this and the pressing force adjusting portion can be a protrusion as described below.

For example, in the embodiment illustrated in Figs. 7(a) and 7(b), a construction is adopted in which a plurality of pressing force adjusting portions 51 having the form of protrusions extend from the concave portion 5b inside the pressing force adjusting frame 5a of the head main body 5.

The height of the pressing force adjusting portion 51 is shorter than that of the pressing force adjusting frame 5a surrounding the same. Accordingly, the pressing force adjusting portions 51 are buried inside the pressure bonding member 6.

In accordance with the present embodiment configured as described above, it is not required to prepare the thermocompression bonding heads 4 based on the number,

allocation position, size or the like of the IC chip 20, and thermocompression bonding can be performed for a plurality of IC chips 20 simultaneously without positional displacement of the IC chips 20.

In the above-described embodiment, a case in which an IC chip is mounted using an anisotropic conductive adhesive film is described as an example. However, the present invention is not limited to this. An adhesive agent that does not contain conductive particles may also be used.

In the above-described embodiment, a case is described as an example in which an IC chip having a bump electrode is mounted. However, an IC chip that does not include a bump electrode can also be used.

CLAIMS

1. A mounting device for an electric component, comprising:

a thermocompression bonding head comprising a pressure bonding member made of a predetermined elastomer, the pressure bonding member provided in a head main body, and

a pressing force adjusting mechanism for adjusting a pressing force corresponding to a region on a pressure bonding surface of the pressure bonding member,

wherein the pressure bonding member is pressed at a predetermined pressure toward an electric component placed on a wiring board.

2. The mounting device according to claim 1, wherein a the pressing force adjusting mechanism comprises a plurality of frame-shaped pressing force adjusting portions provided in the head main body and the pressure bonding member is disposed inside the pressing force adjusting portions.

3. The mounting device according to claim 1, wherein the pressing force adjusting mechanism comprises a pressing force adjusting portion in the form of a protrusion provided inside the head main body.

4. The mounting device according to claim 2 or 3, wherein

heights of the pressing force adjusting portions are differentiated.

5. The mounting device according to claim 1, wherein the pressing force adjusting mechanism is buried in the pressure bonding member.

6. The mounting device according to claim 1, wherein the pressing force adjusting mechanism comprises a cut portion in the pressure bonding member.

7. The mounting device according to claim 1, wherein the pressing force adjusting mechanism comprises a plurality of pressure bonding members integrally formed.

8. The mounting device according to claim 1, further comprising a base for supporting the wiring board, and a heater provided in the base.