DESCRIPTION

# Method of Affixing Adhesive Tape for Die Bonding and Method of Mounting Electronic Component

## Technical Field

The present invention relates to a method of affixing an adhesive tape for die bonding for mounting an electronic component in a prescribed position on a substrate, and to a method of mounting an electronic component using the method of affixing an adhesive tape to mount the electronic component on a substrate.

## Background Art

A method of affixing an electronic component to a substrate using an adhesive tape has been conventionally used. An adhesive tape for die bonding which has adhesive main surfaces on both sides is used in the method. The method is performed as follows.

First, the adhesive tape is cut with a release tape attached thereto. With this, a piece of tape carrying the release tape is prepared. The piece is held by a holding mechanism and is moved. Thereafter, the piece is mounted in a prescribed position on a substrate by the holding mechanism. This step is referred to as a temporary bonding step.

Then, the piece mounted on the substrate is bonded to the substrate by a bonding mechanism. With this, the piece is affixed to the prescribed position on the substrate. That is, one main surface of an adhesive film is affixed to the substrate. This step is referred to as a main bonding step. After this step, a release film still remains on a main surface of the piece opposite to the surface of the piece contacting the substrate.

Then, a sticky tape is pressed against the release film on the piece on the substrate. With this, the release film is adhered to the sticky tape. Thereafter, the sticky tape is transferred so as to remove the release film from the substrate. Therefore, only the adhesive film remains on the substrate. This step is referred to as a peeling-off

step. After the peeling-off step, the other main surface of the adhesive film is exposed.

Thereafter, an electronic component is affixed to the other main surface of the adhesive film. That is, the electronic component is mounted on the substrate with the adhesive film interposed therebetween. This step is referred to as a die bonding step.

The method of mounting an electronic component as described above is described in, for example, Japanese Patent Laying-Open No. 2001-135653.

In the aforementioned temporary bonding step, a holding mechanism 101 and an image pickup mechanism 102 move integrally, as shown in Figs. 9-13.

The temporary bonding step will now be described more specifically.

First, as shown in Fig. 9, an adhesive tape 104 is cut to a desired size at a position 105. With this, a piece 103 is formed, which includes an adhesive film 103a and a release film 103b attached thereto. Then, piece 103 is held by holding mechanism 101. As an example, a main surface of release film 103b is attracted by holding mechanism 101. This step as shown in Fig. 9 is referred to as a holding step S.

Then, as shown in Fig. 10, holding mechanism 101 and image pickup mechanism 102 integrally move from position 105 to a position above a substrate 100 with piece 103 held by holding mechanism 101. This step as shown in Fig. 10 is referred to as a moving step T.

Then, as shown in Fig. 11, when reaching the position above substrate 100, image pickup mechanism 102 recognizes a position on substrate 100 in which the electronic component is to be mounted. This step as shown in Fig. 11 is referred to as a recognizing step U.

Then, as shown in Fig. 12, when recognizing step U is completed, holding mechanism 101 and image pickup mechanism 102 integrally move to a position above the position recognized in recognizing step U. This step as shown in Fig. 12 is referred to as a moving step V.

Then, as shown in Fig. 13, when holding mechanism 101 reaches the position above the position recognized in recognizing step U, holding mechanism 101 mounts

piece 103 in a prescribed position on substrate 100. In this step, piece 103 is adhered to substrate 100. This step is referred to a mounting step W.

In the conventional temporary bonding step as described above, five steps as steps S-W are successively performed, as shown in Figs. 9-13.

Patent Document 1: Japanese Patent Laying-Open No. 2001-135653 (page 13, Fig. 1)

**Disclosure of the Invention**

**Problems to be Solved by the Invention**

Since cost reduction of a substrate has been increasingly required in recent years, a substrate of a matrix type is frequently used, which enables mounting of a large number of electronic components on one substrate. Furthermore, the electronic component mounted on the substrate of the matrix type has become thinner and smaller. Therefore, how to mount a large number of electronic components on a matrix substrate rapidly and with high accuracy becomes an important problem.

In a conventional technique as described above, on the other hand, holding mechanism 101 and image pickup mechanism 102 are provided integrally. Therefore, steps S-W must be successively performed. As a result, no matter how rapidly each of steps S-W is performed, it is difficult to substantially decrease a time required for a whole temporary bonding step. It is very difficult to rapidly perform the temporary bonding step because, for example, image pickup mechanism 102 cannot perform recognizing step U in holding step S. In addition, the temporary bonding step cannot be performed with high accuracy when a time required for each of steps S-W is excessively decreased. That is, the temporary bonding step cannot be performed rapidly and with high accuracy.

In addition, though it is not shown in the drawing, the sticky tape and the release film used in the peeling-off step are transparent. Therefore, when an infrared sensor is used, removal of the release film from the adhesive tape cannot be detected. Even when a material of the release film is not transparent, it is difficult to rapidly detect

removal of the release film by the infrared sensor. Therefore, the electronic component cannot be affixed to the adhesive tape immediately after affixing of the adhesive tape to the substrate.

Furthermore, since a device for performing a step of affixing the adhesive tape to the substrate and a device for performing a step of mounting the electronic component on the adhesive tape as described above are provided separately, these steps cannot be performed successively. Therefore, a time required for a whole operation of mounting the electronic component cannot be decreased.

The present invention is made in view of the above-described problems. An object of the present invention is to provide a method of affixing an adhesive tape for die bonding which allows rapid and highly accurate affixing of the aforementioned adhesive tape (adhesive film) for die bonding to a prescribed position on a substrate.

Another object of the present invention is to provide a method of affixing an adhesive tape for die bonding which allows rapid detection as to whether a release member of the aforementioned adhesive tape for die bonding is removed or not.

A further object of the present invention is to provide a method of mounting an electronic component which allows rapid and highly accurate mounting of the electronic component in a prescribed position on a substrate by successively performing all steps from a step of mounting the aforementioned adhesive tape for die bonding in a prescribed position on a substrate to a step of mounting the electronic component in the prescribed position on the substrate with the adhesive tape for die bonding interposed therebetween.

**Means for Solving the Problems**

In a method of affixing an adhesive tape for die bonding according to an aspect of the present invention, first, a prescribed position on a substrate is recognized by an image pickup mechanism. Then, an adhesive film having adhesive main surfaces on both sides is held using a holding mechanism. Thereafter, the holding mechanism is moved to affix the adhesive film to the prescribed position based on a result of

recognition of the prescribed position. The holding mechanism and the image pickup mechanism move independently of each other, and the step of recognizing and the step of holding are concurrently performed.

According to the method described above, a time required for the step of recognizing the prescribed position and the step of holding the adhesive film can be decreased.

In a method of affixing an adhesive tape for die bonding according to another aspect of the present invention, one color is first applied to a release member. Then, another color which is different from the one color is applied to a sticky tape. An adhesive tape having adhesive main surfaces on both sides and having the release member attached to one main surface thereof is affixed to a substrate. Thereafter, the release member is removed from the adhesive tape using the sticky tape. Then, whether the release member is adhered to the sticky tape or not is detected using a color sensor.

According to the method described above, whether the release member is removed or not can be rapidly detected.

In a method of mounting an electronic component according to a further aspect of the present invention, first, an adhesive film having adhesive main surfaces on both sides and having a release member attached to one main surface thereof is mounted in a prescribed position on a substrate in the first step. Then, in the second step, the adhesive film mounted in the prescribed position is bonded to the substrate using a bonding mechanism. Thereafter, in the third step, the release member is adhered to a sticky tape and is removed from the adhesive film, and only the adhesive film is left on the substrate. Thereafter, in the fourth step, an electronic component is mounted in the prescribed position via the adhesive film. A device for performing the first to third steps and a device for performing the fourth step are provided integrally. In addition, the first to third steps and the fourth step are successively performed.

According to the method described above, the electronic component can be

mounted on the adhesive film left on the substrate immediately after removal of the release film.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

**Brief Description of the Drawings**

Fig. 1 is a plan view of an affixing device used in a method of affixing an adhesive tape for die bonding in an embodiment.

Fig. 2 is a perspective view of a substrate having an adhesive film affixed thereto by the affixing device shown in Fig. 1.

Fig. 3 is a plan view of a situation in which a die bonding device is coupled to the affixing device shown in Fig. 1.

Fig. 4 is a diagram for describing an A step of a temporary bonding step performed by the affixing device shown in Fig. 1.

Fig. 5 is a diagram for describing a B step of the temporary bonding step performed by the affixing device shown in Fig. 1.

Fig. 6 is a diagram for describing a C step of the temporary bonding step performed by the affixing device shown in Fig. 1.

Fig. 7 is a diagram of a holding mechanism of the affixing device shown in Fig. 1.

Fig. 8 is a diagram for describing a peeling-off step performed by the affixing device shown in Fig. 1.

Fig. 9 is a diagram for describing an S step of a conventional temporary bonding step.

Fig. 10 is a diagram for describing a T step of the conventional temporary bonding step.

Fig. 11 is a diagram for describing a U step of the conventional temporary bonding step.

Fig. 12 is a diagram for describing a V step of the conventional temporary

bonding step.

Fig. 13 is a diagram for describing a W step of the conventional temporary bonding step.

**Description of the Reference Signs**

1: substrate, 2: position, 3: adhesive tape, 4: affixing portion, 5: in-magazine portion, 6: out-magazine portion, 7: temporary bonding unit, 8: main bonding unit, 9: peeling-off unit, 10: adhesive film, 11: release film, 12: piece, 13: holding mechanism, 14: image pickup mechanism, 15: bonding mechanism, 16: release film removal mechanism, 17: sticky tape, 18: pressurization mechanism, 19: die bonding unit, 20: mounting mechanism, 21: transfer rail, 22: movement rail, 23: image pickup mechanism, 24 (24a, 24b): cut mechanism, 25 (25a, 25b): feed mechanism, 26: mounting base, 27: position, 28: tip jig, 29: tip portion, 30: shaft portion, 31: load portion, 32 (32a, 32b): magnet, 33: peeling-off base, 34: take-up roller, 35: color sensor, 36: detection board, 40: chip, 50: affixing device, 60: die bonding device, A: holding and recognizing step, B: moving and recognizing step, C: mounting and recognizing step, P: stroke length, 100: substrate, 101: holding mechanism, 102: image pickup mechanism, 103: piece, 103a: adhesive film, 103b: release film, 104: adhesive tape, 105: position, S: holding step, T: moving step, U: recognizing step, V: moving step, W: mounting step.

**Best Modes for Carrying Out the Invention**

A method of affixing an adhesive tape for die bonding and a method of mounting an electronic component according to an embodiment of the present invention will now be described using the drawings.

First, a method of affixing an adhesive tape for die bonding for affixing an adhesive film to a substrate according to an embodiment of the present invention is described referring to Figs. 1 and 2.

An affixing device 50 is used in the method of affixing an adhesive tape for die bonding (hereafter shortly referred to as an "adhesive tape") in the embodiment. As shown in Figs. 1 and 2, affixing device 50 is provided to affix an adhesive film 10 to a

position 2 of a substrate 1. Adhesive film 10 is used to mount a semiconductor chip (hereafter shortly referred to as a "chip") 40 as an electronic component on substrate 1.

Affixing device 50 includes a cut portion for cutting an adhesive tape 3 to form a piece 12 having a desired size. Piece 12 includes adhesive film 10 as a die bonding material and a release film 11 as a release member which are affixed to each other. In addition, adhesive film 10 is a double-faced film having adhesive main surfaces on both sides. Therefore, finally, substrate 1 is affixed to one main surface of adhesive film 10 and chip 40 is affixed to the other main surface thereof. Release film 11 is a member for protecting the other main surface until chip 40 is affixed to the other main surface of adhesive film 10, and is also a member which is attracted by a holding mechanism 13 when piece 12 is moved.

Affixing device 50 also includes an affixing portion 4 for affixing piece 12 to substrate 1. An in-magazine portion 5 is provided on one side of affixing portion 4 for storing substrate 1 before having piece 12 affixed thereto. In addition, an out-magazine portion 6 is provided on the other side of affixing portion 4 for storing substrate 1 after having adhesive film 10 affixed thereto.

Substrate 1 is first transported from in-magazine portion 5 to affixing portion 4. Thereafter, piece 12 is affixed to substrate 1 in an affixing step described below. Then, substrate 1 is transported from affixing portion 4 to out-magazine portion 6. In the affixing step, substrate 1 moves along a substantially straight path. Therefore, the affixing step can be performed efficiently. It is to be noted that, affixing portion 4, in-magazine portion 5 and out-magazine portion 6 are provided on each other in a detachable manner so that an arrangement thereof can be changed as required.

It is to be noted that, though adhesive tape 3 in the embodiment has a two-layer structure formed with adhesive film 10 and release film 11, adhesive tape 3 may have a single layer structure formed with adhesive film 10 alone or a three-layer structure having release films 11 provided on both main surfaces of adhesive film 10.

As shown in Fig. 1, a temporary bonding unit 7, a main bonding unit 8 and a

peeling-off unit 9 are provided in affixing portion 4 in this order from a side of in-magazine portion 5 toward a side of out-magazine portion 6. Since temporary bonding unit 7, main bonding unit 8 and peeling-off unit 9 are provided in a detachable manner, an arrangement thereof can be changed as required. Peeling-off unit 9 is provided to remove release film 11 from adhesive film 10.

In-magazine portion 5 storing substrate 1 before having piece 12 affixed thereto and out-magazine portion 6 storing substrate 1 after having piece 12 affixed thereto have basic elements similar to each other because both are formed for storing substrate 1. In each of in-magazine portion 5 and out-magazine portion 6, a plurality of substrates 1 are provided spaced apart from each other in a vertical direction.

A plurality of substrates 1 each having adhesive film 10 affixed thereto are stored in out-magazine portion 6 described above. Therefore, substrates 1 must be stored spaced apart from each other in out-magazine portion 6 to prevent substrates 1 from being adhered to each other via adhesive film 10. In in-magazine portion 5, however, which stores a plurality of substrates 1 before having adhesive film 10 affixed thereto, the plurality of substrates 1 may be stored contacting each other because substrates 1 are not adhered to each other via adhesive film 10.

In addition, affixing device 50 shown in Fig. 1 has two transfer rails 21 each having a substantially straight form, which are provided in affixing portion 4 for transporting substrates 1 from in-magazine portion 5 through affixing portion 4 to out-magazine portion 6. Each of the two transfer rails 21 has a vertical cross section of a C-shape, as shown in Figs. 4-6. End portions on both sides of substrate 1 are inserted into respective concave portions of the two C-shaped transfer rails 21. In addition, a substrate chuck mechanism (not shown) is provided on transfer rail 21. Therefore, substrate 1 can be transported along transfer rail 21 from in-magazine portion 5 through affixing portion 4 to out-magazine portion 6.

The affixing step as follows is performed using the aforementioned temporary bonding unit 7, main bonding unit 8 and peeling-off unit 9.

First, in temporary bonding unit 7, piece 12 is carried held by holding mechanism 13, and is mounted in position 2 on a main surface of substrate 1. This step is referred to as a temporary bonding step. Then, in main bonding unit 8, piece 12 mounted on substrate 1 is bonded to substrate 1 by a bonding mechanism 15. This step is referred to as a main bonding step. With this, piece 12 is affixed in position 2 on the main surface of substrate 1. In this step, release film 11 remains on piece 12.

Next, a release film removal mechanism 16 is used to remove release film 11. Release film removal mechanism 16 has a sticky tape 17 which is a single-faced tape and a pressurization mechanism 18. Pressurization mechanism 18 presses an adhesive surface of sticky tape 17 against piece 12 on substrate 1. With this, release film 11 is adhered to sticky tape 17. In addition, sticky tape 17 is taken up by a take-up device. Therefore, when pressurization mechanism 18 moves away from sticky tape 17 after release film 11 is adhered to the adhesive surface of sticky tape 17, release film 11 is removed from adhesive film 10 as sticky tape 17 moves. As a result, only adhesive film 10 remains on substrate 1. With this, the affixing step for affixing the adhesive tape to the substrate is completed.

Fig. 2 shows affixing states of eight steps in respective eight positions 2a-2h. Fig. 2 is drawn as such to show affixing states of piece 12 in the above-described affixing step (the temporary bonding step, the main bonding step and the peeling-off step) and affixing states of piece 12 in steps before and after the affixing step in a stepwise manner.

A state of substrate 1 before the temporary bonding step is shown in position 2b. A state of substrate 1 when piece 12 is mounted on substrate 1 by holding mechanism 13, that is, a state of substrate 1 in the temporary bonding step is shown in position 2a.

A state of substrate 1 after piece 12 mounted on substrate 1 is bonded by bonding mechanism 15, that is, a state of substrate 1 after completion of the main bonding step is shown in each of positions 2c and 2d.

A state of substrate 1 just before removal of release film 11 in peeling-off unit 9

is shown in position 2f. In addition, a state of substrate 1 when release film 11 is removed by release film removal mechanism 16, that is, a state of substrate 1 in the peeling-off step is shown in position 2e.

A state before mounting of chip 40 on adhesive film 10 is shown in position 2g. In addition, a state of substrate 1 after chip 40 is completely mounted on adhesive film 10, that is, a state of substrate 1 after completion of a die bonding step is shown in position 2h.

In short, the affixing step performed by affixing device 50 is shown in positions 2a to 2f, and the die bonding step performed by a die bonding device 60 shown in Fig. 3 described below is shown in positions 2g and 2h. Chip 40 is mounted on adhesive film 10 by a mounting mechanism 20 provided in die bonding device 60.

Die bonding device 60 will now be described using Fig. 3.

In an electronic component-mounting device 90 shown in Fig. 3 used in a method of mounting an electronic component in this embodiment, affixing device 50 shown in Fig. 1 and die bonding device 60 shown in Fig. 3 are coupled to each other. Therefore, when the affixing step is completed, the die bonding step can be successively performed. As a result, a whole process for mounting an electronic component on substrate 1 is reduced.

In electronic component-mounting device 90, two transfer rails 21 each having a substantially straight form are provided in affixing portion 4 and die bonding device 60 for transporting substrate 1 from in-magazine portion 5 through affixing portion 4 and die bonding device 60 to out-magazine portion 6. Each of the two transfer rails 21 has a vertical cross section similar to that in affixing device 50 shown in Fig. 1, that is, a C-shape as shown in Figs. 4-6. End portions on both sides of substrate 1 are inserted into respective concave portions of the two C-shaped transfer rails 21. In addition, a substrate chuck mechanism (not shown) is provided on transfer rail 21. Therefore, substrate 1 can be transported along transfer rail 21 from in-magazine portion 5 through affixing portion 4 and die bonding device 60 to out-magazine portion 6.

When die bonding device 60 and affixing device 50 are coupled to each other as shown in Fig. 3, out-magazine portion 6 of affixing device 50 is first detached from affixing portion 4. Then, die bonding device 60 is attached to affixing device 50. Thereafter, out-magazine portion 6 is attached to die bonding device 60. In this situation, substrate 1 having chip 40 mounted thereon is housed in out-magazine portion 6.

According to electronic component-mounting device 90 used in the method of mounting an electronic component in this embodiment, since affixing device 50 and die bonding device 60 are coupled to each other, chip 40 can be affixed to adhesive film 10 further rapidly and with higher accuracy. As a result, a total time required for a series of steps regarding mounting of an electronic component, that is, a cycle time can be decreased.

In addition, the cycle time can further be decreased if temporary bonding unit 7, main bonding unit 8 and a peeling-off unit 9 of affixing device 50 and a die bonding unit 19 of die bonding device 60 can be slid along transfer rail 21.

The aforementioned temporary bonding unit 7 and the temporary bonding step will now be described using Figs. 1-6.

As shown in Figs. 4-6, holding mechanism 13 for holding and moving substrate 1 and an image pickup mechanism 14 for recognizing substrate 1 are provided in temporary bonding unit 7. Besides the aforementioned two mechanisms, temporary bonding unit 7 includes a movement rail 22 for guiding movements of holding mechanism 13 and image pickup mechanism 14, an image pickup mechanism 23 for recognizing piece 12, a cut mechanism 24 for cutting adhesive tape 3, a feed mechanism 25 for feeding adhesive tape 3, and a mounting base 26 on which piece 12 is mounted. Since holding mechanism 13, image pickup mechanism 14, image pickup mechanism 23, cut mechanism 24, feed mechanism 25, and mounting base 26 described above are constructed in a detachable manner, positional relations thereof can be changed.

In addition, each of holding mechanism 13 and image pickup mechanism 14 is

movably provided on movement rail 22. Holding mechanism 13 and image pickup mechanism 14 can move independently of each other guided by movement rail 22. Therefore, each of holding mechanism 13 and image pickup mechanism 14 can move in a direction substantially perpendicular to an extending direction of transfer rail 21 shown in Fig. 1. Therefore, holding mechanism 13 and image pickup mechanism 14 can perform a holding step and an image pickup step at substantially the same time.

In addition, as shown in Figs. 4-6, holding mechanism 13 can move along movement rail 22 between a position 27, in which piece 12 just after being cut is mounted, and position 2 on substrate 1, in which piece 12 is to be affixed. Image pickup mechanism 14 can move from an end portion of mounting base 26 on one side to an end portion on the other side in a width direction.

On the other hand, image pickup mechanism 23 for recognizing the tape is provided in electronic component-mounting device 90 besides image pickup mechanism 14 for recognizing the substrate. While image pickup mechanism 14 for recognizing the substrate can reciprocate along movement rail 22, image pickup mechanism 23 for recognizing the tape is fixed in a position above position 27. Image pickup mechanism 23, however, may reciprocate along movement rail 22 as image pickup mechanism 14. As shown in Figs. 4-6, states such as a state of piece 12 held by holding mechanism 13, a state of adhesive tape 3 cut by cut mechanism 24, and a state of adhesive tape 3 fed by feed mechanism 25 are recognized by image pickup mechanism 23.

Each of cut mechanism 24 and feed mechanism 25 can be integrated with affixing device 50, and is provided on an inner or outer portion of affixing device 50 in a detachable manner.

In addition, feed mechanism 25 supplies adhesive tape 3 into position 27 of cut mechanism 24 for forming piece 12. Cut mechanism 24 cuts adhesive tape 3.

Adhesive tape 3 is cut by a cutter member (not shown) of a cut mechanism 24a shown in Fig. 1. The cutter member cuts adhesive tape 3 fed by a feed mechanism 25a along a width direction. In addition, in this embodiment, a punching member (not

shown) of a cut mechanism 24b is used besides the cutter member to cut the adhesive tape. The punching member cuts the adhesive tape by punching a portion of adhesive tape 3 fed by a feed mechanism 25b. The cutter member and the punching member are provided independently.

In addition, feed mechanism 25 includes a store portion (not shown) for taking up and storing adhesive tape 3. The store portion can take up various kinds of adhesive tape 3.

Though an example is described in which adhesive tape 3 is cut by cut mechanism 24a of a cutter system, the cutter system and a punching system can be switched corresponding to substrate 1 and adhesive tape 3. For this switching of systems, cut mechanism 24 and feed mechanism 25 are constructed to be able to slide in a transfer direction of substrate 1.

The temporary bonding step will now be described in detail using Fig. 4.

Fig. 4 shows a holding and recognizing step in which holding mechanism 13 for holding adhesive tape 3 and image pickup mechanism 14 for recognizing the substrate move independently to concurrently perform the holding step and the recognizing step.

In a holding and recognizing step A shown in Fig. 4, adhesive tape 3 is first fed from feed mechanism 25. Next, adhesive tape 3 is cut to a required size by cut mechanism 24 in position 27. Thereafter, piece 12 is held by holding mechanism 13. Holding mechanism 13 holds piece 12 by attracting a main surface of release film 11 using a suction device such as a pump. Since image pickup mechanism 14 can move independently of an operation of holding mechanism 13, image pickup mechanism 14 recognizes position 2 on substrate 1 using a CCD (Charge Coupled Device) camera or the like while holding mechanism 13 attracts piece 12. Image pickup mechanism 14 can also monitor a state of holding of piece 12 and a state of cutting of piece 12, in addition to position 2 on substrate 1.

Fig. 5 shows a moving and recognizing step B which includes both of conventional moving steps T and V shown in Figs. 10 and 12 and conventional

recognizing step U shown in Fig. 11. In the step shown in Fig. 5, the moving steps and the recognizing step are concurrently performed by holding mechanism 13 and image pickup mechanism 14.

In moving and recognizing step B shown in Fig. 5, piece 12 held by holding mechanism 13 moves from position 27 to position 2 on substrate 1. On the other hand, image pickup mechanism 14 keeps photographing of position 2 until piece 12 is mounted in position 2. In this step, feed mechanism 25 feeds adhesive tape 3 to be cut next time. As described above, according to electronic component-mounting device 90, a time required for mounting an electronic component can be decreased because conventional moving step T and moving step V are concurrently performed, as shown in Fig. 5.

Fig. 6 shows a step corresponding to conventional mounting step W shown in Fig. 13 and a step corresponding to conventional recognizing step U shown in Fig. 11 which are concurrently performed.

In a mounting and recognizing step C shown in Fig. 6, piece 12 is mounted in position 2 recognized by image pickup mechanism 14. In this step, a first piece 12 is mounted in position 2. That is, the temporary bonding step of one piece 12 is completed. During this step, image pickup mechanism 14 moves to a position above next position 2 and photographs position 2.

According to the method of affixing an adhesive tape in the embodiment shown in Figs. 4-6 described above, a number of steps is decreased as compared to a conventional method of affixing an adhesive tape. More specifically, in contrast to a conventional temporary bonding step in which five steps S-W shown in Figs. 9-13 are performed, only three steps A-C shown in Figs. 4-6 are performed in the temporary bonding step of the embodiment, and therefore a time required for performing a whole series of steps is decreased.

The step shown in Figs. 4-6 described above will now be described in more detail using substrate 1 shown in Fig. 2.

First, pieces 12 are mounted in positions 2h and 2g. Then, holding mechanism 13 and image pickup mechanism 14 reciprocate along transfer rail 21, and pieces 12 are mounted in positions 2e and 2f. Thereafter, holding mechanism 13 and image pickup mechanism 14 reciprocate along transfer rail 21 again, and pieces 12 are mounted in positions 2c and 2d. Holding mechanism 13 and image pickup mechanism 14 further reciprocate along transfer rail 21, and pieces 12 are mounted in positions 2a and 2b. As a result, pieces 12 are mounted in all of positions 2 on substrate 1.

It is to be noted that, though holding mechanism 13 holding piece 12 by attracting release film 11 is used in steps A-C of the temporary bonding step shown in Figs. 4-6, another holding mechanism may be used.

In addition, as shown in Fig. 7, holding mechanism 13 includes a tip portion 29, a shaft portion 30, and a load portion 31. A tip jig 28 which is replaceable corresponding to a kind of piece 12 is attached to tip portion 29. Tip portion 29 including tip jig 28 is attached to shaft portion 30. Shaft portion 30 is fitted into load portion 31 in a movable manner. Load portion 31 has a function of achieving reciprocating motion of tip portion 29 (including tip jig 28) and shaft portion 30 in a vertical direction.

In addition, in the temporary bonding step, holding mechanism 13 moves shaft portion 30 downward for a predetermined stroke length P shown in Fig. 7 to press piece 12 with a predetermined load. To attain this movement of shaft portion 30, a load is applied to shaft portion 30 with magnetism. As a structure for performing this step, shaft portion 30 and load portion 31 respectively have magnets 32a and 32b. Shaft portion 30 is fitted into load portion 31, magnet 32a is attached to shaft portion 30, and magnet 32b is attached to load portion 31. Shaft portion 30 is moved upward and downward utilizing repulsive force repulsion and attraction between magnets 32a and 32b. It is to be noted that, holding mechanism 13 may move shaft portion 30 upward and downward with an elastic material such as a compression spring (not shown).

After the temporary bonding step described above, the main bonding step is

performed in main bonding unit 8. The main bonding step will now be described.

As shown in Figs. 1 and 3, bonding mechanism 15 is provided in main bonding unit 8. Bonding mechanism 15 can apply a load larger than that of holding mechanism 13 to adhesive tape 3. Though it is not shown in the drawing, substrate 1 is mounted on a bonding base.

A heating mechanism (not shown) is provided on each of mounting base 26 and the bonding base. Piece 12 is affixed to substrate 1 with a function of the heating mechanism. Therefore, adhesive film 10 can adhere to substrate 1 more easily. It is to be noted that, the heating mechanism may be provided on holding mechanism 13 or bonding mechanism 15 in place of mounting base 26 and the bonding base.

Peeling-off unit 9 and the peeling-off step will now be described in detail using Fig. 8.

Release film removal mechanism 16 shown in Fig. 8 is provided in peeling-off unit 9. Sticky tape 17 for removing the release film and pressurization mechanism 18 are provided in release film removal mechanism 16. In addition, release film removal mechanism 16 includes a peeling-off base 33, a take-up roller 34, a color sensor 35, and a detection board 36. Peeling-off base 33 is provided opposite to pressurization mechanism 18 with substrate 1 interposed therebetween. Take-up roller 34 is used to take up the sticky tape. Color sensor 35 is used to recognize release film 11. Detection board 36 is provided opposite to color sensor 35 with sticky tape 17 interposed therebetween.

A cooling mechanism (not shown) is provided on peeling-off base 33 to facilitate removal of only release film 11 from piece 12 having a two-layer structure. The cooling mechanism cools a portion (a portion of piece 12 on substrate 1) which generates heat during the peeling-off step.

A tip portion of pressurization mechanism 18 is formed with a material having elastic force such as a fluoroplastic. With a construction as such, damaging of adhesive film 10 due to excessive pressurizing force is avoided. In addition, a substantially

uniform pressure can be applied to sticky tape 17.

In addition, a sticky tape supply mechanism (not shown) for applying tensile strength to sticky tape 17 or decreasing the tensile strength is provided in release film removal mechanism 16 shown in Fig. 8. The tape supply mechanism has a pair of reels. The pair of reels are formed with a feed reel for feeding sticky tape 17 to piece 12 affixed to substrate 1 and a take-up reel for taking up sticky tape 17 to which release film 11 removed from piece 12 is adhered.

Color sensor 35 is provided between peeling-off base 33 and the take-up reel. Color sensor 35 is a sensor which can detect colors. Therefore, release film 11 can be easily detected when one color is applied to release film 11 beforehand and another color different from the one color is applied to sticky tape 17. As a result, whether release film 11 is removed from adhesive tape 3 or not can be rapidly recognized. When color sensor 35 detects release film 11, a step of affixing chip 40, for example, may be performed for adhesive tape 10 on substrate 1 from which release film 11 detected is removed. In addition, when color sensor 35 does not detect release film 11, the step of affixing chip 40 may not be performed for adhesive tape 10 on substrate 1 on which release film 11 not detected remains without being released, and this operation may be stopped. Furthermore, when color sensor 35 does not detect release film 11, it may be regarded as occurrence of an abnormal condition in an operation in which adhesive tape 10 is not affixed to substrate 1 in a proper state, and the occurrence of the abnormal condition may be notified to an operator by warning means such as a buzzer.

Detection board 36 shown in Fig. 8 is provided for more accurate detection of the one color applied to release film 11 by color sensor 35. Therefore, another color different from the one color applied to release film 11 is applied to a surface of detection board 36 opposing to a side of sticky tape 17. Detection board 36, however, is not an essential element of the present invention.

As described above, according to electronic component-mounting device 90, whether release film 11 is removed from adhesive film 10 or not can be detected

accurately and rapidly by color sensor 35 even when release film 11 and sticky tape 17 are transparent, since colors different from each other are respectively applied to release film 11 and sticky tape 17.

It is to be noted that, though adhesive tape 3 in this embodiment has a two-layer structure, when an adhesive tape having a single layer structure is used, the peeling-off step described above may not be performed and only the temporary bonding step and the main bonding step may be performed. In addition, a structure of adhesive tape 3 is not limited to the two-layer structure, and it may be a multilayer structure including at least three layers.

In addition, when a flip chip substrate is used as substrate 1 in this embodiment, chip 40 may be mounted on substrate 1 via a bump (connection electrode). Furthermore, on an upper surface of a first chip 40 on substrate 1, a second chip may be mounted via another adhesive film having adhesive main surfaces on both sides.

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 spirit and scope of the present invention being limited only by the terms of the appended claims.

## CLAIMS

1. A method of affixing an adhesive tape for die bonding, comprising the steps of:

recognizing a prescribed position (2) on a substrate (1) by an image pickup mechanism (14);

holding an adhesive film (10) having adhesive main surfaces on both sides using a holding mechanism (13); and

moving said holding mechanism (13) to affix said adhesive film (10) to said prescribed position (2) based on a result of recognition of said prescribed position (2); wherein

said holding mechanism (13) and said image pickup mechanism (14) can move independently of each other; and

said step of recognizing and said step of holding can be concurrently performed.

2. A method of affixing an adhesive tape for die bonding, comprising the steps of:

recognizing a prescribed position (2) on a substrate (1) by an image pickup mechanism (14);

holding an adhesive film (10) having adhesive main surfaces on both sides and having a release member (11) attached to one main surface thereof using a holding mechanism (13);

moving said holding mechanism (13) to affix the other main surface of said adhesive film (10) to said prescribed position (2) based on a result of recognition of the prescribed position (2) on said substrate (1);

removing said release member (11) from said adhesive film (10) affixed to the prescribed position (2) on said substrate (1) by adhering said release member (11) to a sticky tape (17); and

detecting whether said release member (11) is adhered to said sticky tape (17) or not; wherein

said holding mechanism (13) and said image pickup mechanism (14) can move independently of each other;

said step of recognizing and said step of holding can be concurrently performed; and

said step of detecting includes the step detecting whether said release member (11) is adhered to said sticky tape (17) or not by means of detecting one color that is applied to said release member (11) beforehand by using a color sensor (35).