

DESCRIPTION

CARRIER TAPE CUTTING APPARATUS
AND COMPONENT MOUNTING MACHINE

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TECHNICAL FIELD

The present invention relates to a cutting apparatus for cutting a carrier tape (band-shaped long material) emptied after electronic components or the like components stored in the carrier tape and carried are taken out of the tape to be mounted to a printed board or the like, and a component mounting machine having the carrier tape cutting apparatus.

BACKGROUND ART

Recent machines for mounting electronic components to printed boards are adapted to operate at high speed, and high-speed supply of the electronic components is demanded to cope with the high-speed operation. For this reason, an increasing number of the mounting machines are fitted to a package transfer system realizing a high supply speed and stable supply of the electronic components to the machines with the use of a carrier tape, that is, with using a band-shaped long material having a plurality of recesses to hold the electronic components therein and carry them.

In a conventional electronic component mounting machine, the carrier tape emptied after the electronic component is taken outside therefrom is sequentially cut by

a cutting apparatus installed in the machine (referring to Japanese unexamined Patent Publication Nos. 1-164587 and 1-310891).

5 The conventional carrier tape cutting apparatus installed in the electronic component mounting machine will be described below. Fig. 4 is a perspective view of an appearance of the electronic component mounting machine, Fig. 5 is a diagram showing the constitution of the conventional carrier tape cutting apparatus in a state
10 while set to the electronic component mounting machine of Fig. 4, Fig. 6A is a perspective view showing the appearance of the constitution in detail of the conventional carrier tape cutting apparatus of Fig. 5, Figs. 6B and 6C are a side sectional view and a top view of the
15 same apparatus respectively and Fig. 7 is a flow chart for explaining the operation of the conventional carrier tape cutting apparatus shown in Figs. 4, 5, and 6A-6C.

Referring to Fig. 4, references 1-3 represent respectively a main body part of the electronic component
20 mounting machine, an electronic component feeding apparatus set at the main body part 1 of the electronic component mounting machine, and a carrier tape wound to a reel 4 of the electronic component feeding apparatus 2 and holding electronic components therein. In Fig. 5, reference
25 numerals 5, 6, 8, 9 respectively indicate a suction nozzle 5 sucking the electronic components out of the carrier tape 3 sent from the reel 4 of the electronic component feeding apparatus 2 to take out them therefrom, a dust pipe 6

forwarding an emptied carrier tape 7 after the electronic component is taken outside by the suction nozzle 5, a cutting apparatus 8 cutting the emptied carrier tape 7 sent from the dust pipe 6, and a dust box 9 storing the carrier tape 7 cut by the cutting apparatus 8 via a dust chute 10.

In Figs. 6A, 6B, and 6C, reference numerals 11-18 respectively indicate a main body part of the carrier tape cutting apparatus 8, a slide groove formed in the main body part 11, an upper lid covering the slide groove 12, a movable blade sliding in the slide groove 12 of the main body part 11, a fixed blade disposed above the slide groove 12 for cutting the carrier tape in cooperation with the movable blade 14, a carrier tape insertion part where the emptied carrier tape 7 is inserted to a shear part of the movable blade 14 and the fixed blade 15, a roller follower, and a driving part.

The conventional carrier tape cutting apparatus set to the electronic component mounting machine and constituted as above will be discussed with reference to the flow chart of Fig. 7 explanatory of the operation thereof. The carrier tape 3 holding electronic components therein is fitted to the electronic component feeding apparatus 2 in a state while being wound to the reel 4, set at the main body part 1 of the electronic component mounting machine, then sent forward by one pitch by the electronic component feeding apparatus 2 (step 11). After the electronic component stored in the carrier tape 3 is sucked by the suction nozzle 5 (step 12), the carrier tape

as the emptied carrier tape 7 discharged from the dust pipe 6 of the electronic component feeding apparatus 2 is inserted through the carrier tape insertion part 16 of the cutting apparatus 8. At this time, the movable blade 14 slides toward a forward end in the slide groove 12, thereby cutting the carrier tape 7 by a shearing force exerted together with the fixed blade 15 (step 13). The cut carrier tape 7 drops in the dust chute 10 to be accommodated and collected in the dust box 9.

In the above-described conventional constitution of the carrier tape cutting apparatus 8, the sent carrier tape 7 is simply sequentially cut. That is, the carrier tape is collected in the same dust box 9 without being sorted whether the carrier tape 7 is formed of paper or resin.

The present invention is devised to solve the above issue inherent in the prior art, and has for its object to provide a carrier tape cutting apparatus whereby a cut carrier tape can be sorted and collected in accordance with a material thereof as conventional without any limit to a set position where the carrier tape holding components therein is set to a component feeding apparatus, and a component mounting machine having the carrier tape cutting apparatus.

DISCLOSURE OF INVENTION

In order to solve the aforementioned issue, the present invention is constituted as follows.

There is provided a carrier tape cutting

apparatus according to a first aspect of the present invention, which comprises:

5 a movable blade movable back and forth with having edges respectively set at a side of a forward end and at a side of a return end of reciprocation;

fixed blades having edges respectively set at the side of the forward end and at the side of the return end to be faced to the edges at the forward end and the return end of the movable blade, thereby cutting a carrier tape with a shearing force; and

10 carrier tape storage parts which are disposed below respective shear parts of the edge at the forward end of the movable blade and the corresponding edge of the fixed blade and of the edge at the return end of the movable blade and the corresponding edge of the fixed blade

15 when the carrier tape emptied after a component is taken out is cut by the edge at the forward end or at the return end of the movable blade and the edge of the fixed blade at the same side as the cutting edge of the movable blade, so

20 partitioned that the cut carrier tape is sorted and collected in accordance with a kind thereof.

According to a second aspect of the present invention, there is provided the carrier tape cutting apparatus of the first aspect, which comprises flaps

25 respectively set under the edges at the forward end and the return end of the movable blade to move integrally with the edges at the forward end and the return end of the movable blade, thereby guiding the cut carrier tape to drop in a

predetermined one of the partitioned carrier tape storage parts.

According to a third aspect of the present invention, there is provided the carrier tape cutting apparatus according to the first aspect or second aspect of the present invention, a driving device reciprocating the movable blade; and

a control device determining an operation direction of the movable blade in accordance with the kind of the carrier tape and then controlling driving of the driving device.

A component mounting machine according to a fourth aspect of the present invention has the carrier tape cutting apparatus according to any one of the first-third aspects.

In a method according to a fifth aspect of the present invention for mounting a component with the use of the component mounting machine of the fourth aspect of the present invention, the electronic component mounting machine comprises:

while sequentially sending the carrier tape holding components therein, taking out one of the components from the carrier tape and mounting the component to a board;

determining an operation direction of the movable blade in accordance with the kind of the carrier tape; and

driving the movable blade in accordance with the determined operation direction, thereby cutting the carrier

tape emptied after the component is taken out by the edge at the forward end of the movable blade and the corresponding edge of the fixed blade at the same side as the edge of the movable blade or by the edge at the return end of the movable blade and the corresponding edge of the fixed blade at the same side as the edge of the movable blade, and simultaneously sorting and collecting the cut carrier tape in accordance with the kind of the tape into the carrier tape storage parts.

In the above constitution, the emptied carrier tape after the component is taken therefrom is cut by the movable blade having edges both at the forward end and at the return end and the fixed blade sliding to the edges of the forward end and the return end of the movable blade thereby cutting the carrier tape with a shearing force, and the cut carrier tape is sorted and collected in the carrier tape storage parts partitioned for every kind of the carrier tape below respective shear parts between the edge at the forward end of the movable blade and the fixed blade and between the edge at the return end of the movable blade and the fixed blade. The carrier tape can be sorted and collected separately for every kind in a simple operation of changing a drive direction of the movable blade without having any relation with the supply side of the carrier tape holding components therein.

BRIEF DESCRIPTION OF DRAWINGS

These and other aspects and features of the

present invention will become clear from the following description taken in conjunction with the preferred embodiments thereof with reference to the accompanying drawings, in which:

5 Fig. 1 is a diagram showing the constitution of a carrier tape cutting apparatus in an embodiment of the present invention;

10 Fig. 2A is a sectional side view of the carrier tape cutting apparatus in the embodiment of the present invention;

 Figs. 2B, 2C are sectional side views of the carrier tape cutting apparatus according to a first and a second embodiments of the present invention in a state while cutting a carrier tape;

15 Fig. 3A is a flow chart of the operation of the carrier tape cutting apparatus shown in Figs. 1 and 2A-2C;

 Fig. 3B is a perspective view of a component mounting machine according to a third embodiment of the present invention;

20 Fig. 4 is a perspective view showing an appearance of an electronic component mounting machine;

 Fig. 5 is a diagram of the constitution of a conventional carrier tape cutting apparatus in a state when set to the electronic component mounting machine of Fig. 4;

25 Fig. 6A is a perspective view of an appearance of the conventional carrier tape cutting apparatus;

 Fig. 6B is a sectional side view of the carrier tape cutting apparatus of Fig. 6A;

Fig. 6C is a plan view of the carrier tape cutting apparatus of Fig. 6A; and

Fig. 7 is a flow chart explanatory of the operation of the conventional carrier tape cutting apparatus of Figs. 5 and 6A-6C.

BEST MODE FOR CARRYING OUT THE INVENTION

Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout the accompanying drawings.

A carrier tape cutting apparatus according to a first embodiment of the present invention is so constituted as to cut an emptied carrier tape after an electronic component is taken outside, by a movable blade having edges both at a forward end and at a return end, and a fixed blade acting a shearing force to the edges at the forward end and return end of the movable blade. A partitioned dust box is arranged below shear parts between the forward end and return end edges of the movable blade and the fixed blades to sort and collect the cut carrier tapes in accordance with kinds of the tapes. In this constitution, the shear part where the emptied carrier tape is cut is selected to be either between the forward end edge of the movable blade and the fixed blade or between the return end edge of the movable blade and the fixed blade, that is, the carrier tape cutting positions are changed, so that the carrier tapes can be sorted in accordance with the kinds thereof. Or a cut position on the carrier tape is changed,

thereby sorting the carrier tapes in accordance with the kinds of the tapes.

5 In a carrier tape cutting apparatus, according to a second embodiment of the present invention, a flap is provided under each of the forward end edge and return end edge of the movable blade in the carrier tape cutting apparatus of the first embodiment. The flaps move integrally with the edges thereby guiding the cut carrier tapes to fall into a predetermined part of the partitioned
10 dust box. In the constitution with the flaps respectively attached to the forward end edge and the return end edge of the movable blade, the carrier tape cut at the respective shear part between the movable blade and the fixed blade is prevented from falling to a wrong part of the partitioned
15 dust box.

In a carrier tape cutting apparatus, according to a third embodiment of the present invention, an electronic component mounting machine is provided which includes the carrier tape cutting apparatus of the first embodiment,
20 wherein the carrier tape with electronic components held therein is set in a manner to be sequentially sent out, so that the electronic components are taken out from the carrier tape and mounted to boards, while an operation direction of the movable blade is determined in accordance
25 with the kind of the carrier tape. According to the construction, irrespective of a manner how to set the carrier tape holding the electronic components therein to the electronic component mounting machine, and simply by

determining the operation direction of the movable blade in conformity with the kind of the carrier tape, the cut carrier tape is let to drop into a predetermined part of the partitioned dust box.

5 The above-described first-third embodiments will be more fully described with reference to the drawings.

10 Fig. 1 is a diagram of the constitution of the carrier tape cutting apparatus in the first embodiment of the present invention when set to an electronic component mounting machine of Fig. 3B. Fig. 2A is a sectional side view showing the constitution in detail of the carrier tape cutting apparatus of Fig. 1. Figs. 2B and 2C are sectional side views of the carrier tape cutting apparatus in a state when cutting a carrier tape, and Fig. 3A is a flow chart
15 descriptive of the operation of the carrier tape cutting apparatus of Figs. 1 and 2A-2C. In addition to the carrier tape cutting apparatus of the first embodiment, Figs. 2A-2C include flaps 35, 36 of the carrier tape cutting apparatus according to the second embodiment in a state to be fixed
20 to a lower face of a movable blade 30.

 In Fig. 1, reference numeral 19 denotes a suction nozzle which sucks and takes out an electronic component from a carrier tape 3 sent from a reel 21 of an electronic component feeding apparatus 20. Reference numeral 22
25 denotes a dust pipe which sends a carrier tape 23 emptied after the electronic component is taken out by the suction nozzle 19. Reference numeral 24 denotes a cutting apparatus which cuts the emptied carrier tape 23 sent from

the dust pipe 22. Reference numeral 25 denotes dust box as an example of a carrier tape storage part which stores the carrier tape 23 cut by the cutting apparatus 24 via a dust chute 26. In Figs. 2A, 2B, and 2C, reference numeral 27 denotes a main body part of the carrier tape cutting apparatus 24, 28 denotes a slide groove formed at the main body part 27, 29 denotes an upper lid covering the slide groove 28, 30 denotes the movable blade sliding in the slide groove 28 of the main body part 27, 31 and 32 denote edges which are provided to face each other in a carrier tape insertion space 110 respectively at the sides of a forward end and a return end of the movable blade 30 sliding in the slide groove 28, 33 and 34 denote fixed blades which are formed to face each other in a carrier tape insertion space 110 to exert a shearing force with the corresponding edges 31, 32 at the forward end and the return end of the movable blade 30, thereby cutting the carrier tape, 35 and 36 denote flaps moving along with the slide of the movable blade 30 and fixedly attached below the edges 31, 32 at the forward end and the return end, 37 denotes a first dust box arranged below a shear part defined between the edge 31 at the forward end of the movable blade 30 and the fixed blade 33, 38 denotes a second dust box disposed below a shear part of the edge 32 at the rear end of the movable blade 30 and the fixed blade 34, and 39 denotes a driving part comprising a roller follower engaged with the movable blade 30 and a motor rotating the roller follower back and forth, etc. thereby

reciprocating the movable blade 30 between the forward end and the return end. The carrier tape 23 emptied after the electronic component is taken out is inserted to the shear part between the edge 31 of the movable blade 30 and the fixed blade 33 or between the edge 32 of the movable blade 30 and the fixed blade 34.

The operation of the carrier tape cutting apparatus in the first embodiment constituted as hereinabove will be depicted with reference to the flow chart of Fig. 3A for explaining the operation and the component mounting machine 141 in the third embodiment of the present invention shown in Fig. 3B.

By way of example, here, the carrier tape 23 of paper is cut at the shear part between the edge 31 of the movable blade 30 and the fixed blade 33, and the carrier tape 23 of resin is cut at the shear part between the edge 32 of the movable blade 30 and the fixed blade 34.

As indicated in Fig. 3B, the carrier tape 3 storing electronic components is installed in the electronic component feeding apparatus 20 while wound to the reel 21, which is set at a main body part 1 of the electronic component mounting machine. The carrier tape is transferred by one pitch by the electronic component feeding apparatus 20 (step 1). The carrier tape 3 and the electronic component stored in the carrier tape are sucked by the suction nozzle 19 (step 2). Then, the emptied carrier tape 23 discharged through the dust pipe 22 of the electronic component feeding apparatus 20 is detected by a

control device 100 as to whether the emptied carrier tape 23 is formed of paper or resin (step 3). For detecting whether the carrier tape 23 is of paper or resin by the control device 100, for example, material information of the carrier tape holding components to be used is input to the control device 100 from a control device of the component feeding apparatus 20 or component mounting machine main body, so that whether the carrier tape is formed of paper or resin is judged on the basis of the input information when cut, and the driving of the driving part 39 is accordingly controlled. When the carrier tape 23 is judged to be paper by the control device 100, the driving part 39 moves the movable blade 30 to the forward end by the control of the control device 100 (step 4), the emptied carrier tape 23 is cut at the shear part of the edge 31 and the fixed blade 33 and dropped into the first dust box 37 under the guidance of the flaps 35, 36. On the other hand, when the carrier tape 23 is judged to be of resin by the control device 100, the driving part 39 moves the movable blade 30 to the return end through the control by the control device 100 (step 5), the emptied carrier tape 23 is cut at the shear part of the edge 32 and fixed blade 34, guided by the flaps 35, 36 and dropped to the second dust box 38. In the thus-discussed manner, it can be selected in accordance with the kind of the emptied carrier tape 23 by the control device 100 that at which of the forward end and the return end of the movable blade 30 the emptied carrier tape 23 is to be cut. A drive

direction of the movable blade 30 can be controlled in accordance with the kind, such as material, of the carrier tape if the kind is registered in the electronic component mounting machine or the like beforehand for every component to be mounted.

After step 4 or 5, the movable blade 30 is always returned to a neutral position at the center to be prepared for cutting a next carrier tape 23 (step 6). Meanwhile, the component sucked by the suction nozzle in step 2 is mounted to a predetermined point of a board at the component mounting machine (step 7). The operation in step 7 can be carried out concurrently with operations in steps 3-6. It is detected last in step 8 whether or not the program is finished, that is, whether or not the components are completely mounted to the board. The mounting operation is terminated when the components are perfectly mounted to the board, whereas the program returns to step 1 unless the operation is not finished.

Because of the flaps 35, 36 set to the edges 31, 32 of the movable blade 30, the carrier tape 23 can be sorted and separately collected even in the constitution whereby the movable blade 30 moves when the carrier tape is cut. Distances between the edges 31, 32 of the movable blade 30 and the fixed blades 33, 34 and inclinations thereof may be adjusted to assign either set of the edge and the blade for the paper or resin carrier tape. The flaps 35, 36 are preferably set to the movable blade so that the flaps 35, 36 can be long enough to guide the cut

carrier tape into a predetermined dust box, not in the other dust box, without interfering with the driving of the movable blade. More specifically, as shown in Figs. 2A-2C, a partition 150 between the first dust box 37 and the second dust box 38 is made short not to be in touch with the flaps 35, 36 and regulated to be nearly even with the flaps 35, 36 when the movable blade 30 stops at each of the forward end and the return end so as to prevent the carrier tape 23 from being stored in a different dust box. In contrast, a partition 151 at the right side of the first dust box 37 and a partition 152 at the left side of the second box 38 are longer than the partition 150 to be in touch with the outside of the flaps 35, 36, thereby preventing the carrier tape 23 from popping outside the dust boxes. Since the flaps 35, 36 move integrally with the movable blade 30, even if the carrier tape 23 is inserted into the insertion space 110, 111 before cut, a lower end of the carrier tape 23 can be surely guided and moved to the predetermined dust box owing to the movement of the flaps 35, 36 along with the movable blade 30. The flaps are not limited to such design as project toward the dust box side from the movable blade, and oppositely can be projected from the dust box side to the movable blade side.

In a way of driving the movable blade 30 by the driving part 39, similar to the conventional example of Fig. 6C, a disk may be fixed to a rotary shaft of the motor as an example of a main body of the driving part 39, and the roller follower (corresponding to 17 in Fig. 6C) rotatably

set to the disk with an eccentricity from an axial center of the rotary shaft is loosely fitted in a long hole extending in a direction approximately orthogonal to a movement direction of the movable blade, whereby the roller
5 follower is moved in the long hole through the rotation of the rotary shaft of the motor in the forward and backward directions. As a result, the rotational movement of the rotary shaft is converted to a linear motion of the movable blade 30 and thus, the movable blade 30 is reciprocated.
10 However, the present invention is not restricted to this arrangement and other known structures may be suitably adopted.

The present invention is not limited to the foregoing embodiments and can be executed in various other
15 forms.

For instance, the material of the carrier tape may be adapted to be judged by an operator, not by the control device 100.

The dust box 25 is not limited to two, i.e., the
20 first dust box 37 and the second dust box 38. Four or more dust boxes may be arranged separately for the dust box 25, the movable blade 30, and fixed blade 33 so that the cut carrier tape can be sorted and collected.

Although one carrier tape cutting apparatus may
25 be allotted for each component feeding apparatus, only one carrier tape cutting apparatus may be used in the whole of the component mounting machine and moved by a driving device 120 such as an air cylinder or a motor represented

by chain lines in Fig. 1 to below the component feeding apparatus where the carrier tape is cut.

The entire disclosure of Japanese Patent Application No. 8-225920 filed on August 8, 1996 including the specification, claims, drawings and summary are incorporated herein by reference in its entirety.

Although the present invention has been fully described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. Such changes and modifications are to be understood as included within the scope of the present invention as defined by the appended claims unless they depart therefrom.



CLAIMS

1. A carrier tape cutting apparatus which comprises:

5 a movable blade (30) movable back and forth with having edges (31, 32) respectively set at a side of a forward end and at a side of a return end of reciprocation;

10 fixed blades (33, 34) having edges respectively set at the side of the end forward and the return end to be faced to the edges at the forward end and the return end of the movable blade, thereby cutting a carrier tape with a shearing force; and

15 carrier tape storage parts (37, 38) which are disposed below respective shear parts of the edge at the forward end of the movable blade and the corresponding edge of the fixed blade and of the edge at the return end of the movable blade and the corresponding edge of the fixed blade when a carrier tape (23) emptied after a component is taken out is cut by the edge at the forward end or at the return end of the movable blade and the edge of the fixed blade at the same side as the cutting edge of the movable blade, so partitioned that the cut carrier tape is sorted and collected in accordance with a kind thereof.

20 2. A carrier tape cutting apparatus according to claim 1, which comprises flaps (35, 36) which are respectively set under the edges at the forward end and the return end of the movable blade to move integrally with the edges at the forward end and the return end of the movable blade, thereby guiding the cut carrier tape to drop in a

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predetermined one of the partitioned carrier tape storage parts.

3. A carrier tape cutting apparatus according to claim 1 or 2, which comprises:

5 a driving device (39) reciprocating the movable blade; and

a control device (100) determining an operation direction of the movable blade in accordance with the kind of the carrier tape and then controlling driving of the driving device.

4. A component mounting machine comprising the carrier tape cutting apparatus according to any one of claims 1-3.

5. In a method for mounting a component with the use of the component mounting machine according to claim 4, the electronic component mounting machine comprising:

15 while sequentially sending the carrier tape (3) holding components therein, taking out one of the components from the carrier tape and mounting the component to a board;

20 determining an operation direction of the movable blade in accordance with the kind of the carrier tape; and

driving the movable blade in accordance with the determined operation direction, thereby cutting the carrier tape (23) emptied after the component is taken out by the edge at the forward end of the movable blade and the corresponding edge of the fixed blade at the same side as the edge of the movable blade or by the edge at the return end of the movable blade and the corresponding edge of the



fixed blade at the same side as the edge of the movable blade, and simultaneously sorting and collecting the cut carrier tape in accordance with the kind of the tape into the carrier tape storage parts.