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SPECIFICATION

TITLE OF THE INVENTION

ELECTRONIC COMPONENT MOUNTING APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

The present invention relates to an electronic component mounting apparatus and method for mounting electronic components on boards thereby to produce electronic circuit boards, and more particularly, to an electronic component mounting apparatus equipped with an exchange device for support blocks supporting the boards, and an electronic component mounting method of exchanging support blocks supporting the boards.

A conventional art will be described with reference to Figs. 5A and 5B.

Figs. 5A and 5B are enlarged sectional views of an essential portion of a support block in a conventional electronic component mounting apparatus. In Figs. 5A and 5B, a board 14 to which electronic components, etc. are mounted is positioned at a predetermined position over a support block 16 by a transfer belt device 15. The support block 16 is then raised and the board 14 is held on support pins 17 provided in the support block 16. After this, electronic components, etc. are mounted to the board 14.

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Setting positions of the support pins in the support block are selected depending on the states of rear faces of boards to be produced. In switching the kind of boards in the conventional mounting apparatus, therefore, the support blocks should be changed in accordance with the states of rear faces of the boards, which requires an additional time. In the case where the volume of production is relatively low and there are a wide variety of kinds of products, namely, boards to be made, this exchange of support blocks inconveniently deteriorates the productivity.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide an electronic component mounting apparatus and method which shorten a time required for switching kinds of boards to be produced and enhance the working efficiency of facilities, thereby improving the productivity.

In accomplishing these and other aspects, according to a first aspect of the present invention, there is provided an electronic component mounting apparatus comprising:

a plurality of support blocks one of which supports a board when mounting an electronic component,

wherein a support block among the plurality of support blocks is automatically selected and exchanged in accordance with switching of a kind of boards.

According to a second aspect of the present invention, there is provided an electronic component mounting apparatus according to the first aspect, further comprising: a storing device for storing the plurality of support blocks; and a support block moving device for selecting one of the support blocks stored in the storing device in accordance with the switching of the kind of boards and moving the selected support block from the storing device to a position where the board is supported by the selected support block.

According to a third aspect of the present invention, there is provided an electronic component mounting apparatus according to the first aspect, further comprising a single support block driving device for upward moving the support block to support the board when the electronic component is mounted on the board, downward moving the support block to stop supporting the board, and exchanging the support block with another support block.

According to a fourth aspect of the present invention, there is provided an electronic component mounting apparatus according to the second aspect, wherein the support block moving device upward moves the support

block to support the board when the electronic component is mounted on the board, and downward moves the support block to stop supporting the board.

According to a fifth aspect of the present invention, there is provided an electronic component mounting method comprising:

selecting one of support blocks in correspondence with a kind of board to be supported, based on data indicating relationship between kinds of boards and the support blocks corresponding to the kinds of boards; and

exchanging a present support block with the selected support block.

According to a sixth aspect of the present invention, there is provided an electronic component mounting method according to the fifth aspect, further comprising, before selecting the support block, inputting the data of indicating the relationship between the kinds of boards and the support blocks corresponding to the kinds of boards.

According to a seventh and an eighth aspects of the present invention, there is provided an electronic component mounting method according to the fifth and sixth aspects, further comprising displaying an error when the selected support block in selecting the support block is not stored in a support block storing device for storing

the support blocks to be exchanged in exchanging the support block.

According to a ninth aspect of the present invention, there is provided an electronic component mounting apparatus according to the first aspect, wherein the support blocks are different in positions of pins for supporting the boards.

According to a tenth aspect of the present invention, there is provided an electronic component mounting apparatus according to the second aspect, wherein the support blocks are different in positions of pins for supporting the boards.

According to an eleventh aspect of the present invention, there is provided an electronic component mounting method according to the fifth aspect, wherein the support blocks are different in positions of pins for supporting the boards.

According to a twelfth aspect of the present invention, there is provided an electronic component mounting method according to the sixth aspect, wherein the support blocks are different in positions of pins for supporting the boards.

BRIEF DESCRIPTION OF THE 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:

Fig. 1 is a schematic diagram of an electronic component mounting apparatus for carrying out an electronic component mounting method, according to one embodiment of the present invention;

Fig. 2 is an enlarged sectional view of a portion of the apparatus for explaining the embodiment of the present invention;

Fig. 3 is a flow chart showing the method;

Figs. 4A and 4B are views showing different clamp mechanisms between a cylinder and a board of the apparatus; and

Figs. 5A and 5B are enlarged sectional views of an essential portion of a support block of an electronic component mounting apparatus in the conventional art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

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.

Hereinbelow, one embodiment of the present invention will be described with reference to Figs. 1 and 2. Fig. 1 schematically shows an electronic component mounting apparatus according to one embodiment of the present invention. Fig. 2 is an enlarged sectional view of a portion explanatory of a support block exchange device of the apparatus in the present invention. First, a mounting process for electronic components will be discussed with reference to Fig. 1. In Fig. 1, a head part 1 having a suction nozzle for sucking an electronic component is positioned by an XY robot 2 movable in X and Y directions perpendicularly crossed each other. The head part 1 sucks a predetermined electronic component from a component feed part 3, which is then positioned over a component recognition camera 4. A suction posture of the sucked component is detected on the basis of an image obtained by the recognition camera 4. A shifting amount of the head part 1 when sucking the electronic component is corrected based on the obtained data of the suction posture. The head part 1 is consequently positioned at a predetermined position on a board 5, so that the electronic component is accurately mounted to the predetermined position on the board 5.

Now, a take-in and a take-out processes for the board 5 according to the embodiment will be explained with reference to Fig. 2.

In Fig. 2, reference numerals respectively represent: 6 a transfer belt device for transferring the board 5; 7 support pins disposed on each support block 8; 9 a motor for driving up and down a support block holding table 10 holding the support block 8; 11 a rack, serving as a support block storing device, provided at one side of the holding table 10 for storing a plurality of support blocks 8 with support pins 7 arranged in different manners; 12 a clamp part for exchanging the support blocks 8; and 13 a cylinder for driving the clamp part 12.

The motor 9 rotates a driving pulley 9a which is connected to a pair of pulleys 9d by a belt 9b so as to rotate the pulleys 9d together with the rotation of the driving pulley 9a. A pair of driving shafts 9c has the pulleys 9d fixed to the lower ends thereof and nuts 10a fixed to the holding table 10 and engaged with the driving shafts 9c so that the driving shafts 9c rotate with respect to the engaged nuts 10a to move upward and downward the holding table 10. Thus, when the motor 9 rotates the driving pulley 9a in both directions, the pulleys 9d are rotated by the belt 9b so as to rotate the driving shafts 9c in both directions to move upward and downward the

holding table 10. The holding table 10 has a pair of guide rails 10c for guiding the support block 8 on the holding table 10 in a direction perpendicular to the transport direction of the board 5 being performed by the transfer belt device 6. Then, a support block moving device is constituted by the motor 9, the driving pulley 9a, the belt 9b, the driving shafts 9c, the pulleys 9d, the holding table 10, the clamp portion 12, and the cylinder 13.

The cylinder 13 has the clamp part 12 at the end of the piston rod 13a. The clamp part 12 clamps the support block 8 on the holding table 10 so as to position the support block 8 thereon without any movement. One example of the claim part 12 is shown by 12a in Fig. 4A. This clamp part 12a includes a rotatable plate 13b fixed to the end of the piston rod 13a and a pair of positioning pins 8a fixed on the support block 8. When the holding table 10 with no support table 8 thereon is faced to the support block 8 in one slot of the rack 11 and the piston rod 13a of the cylinder 13 is clockwise rotated from a removal position shown by dotted lines to an engaging position shown by solid lines, the positioning pins 8a of the support block 8 are inserted into and engaged with holes 13c of the rotatable plate 13b and the piston rod 13a is forward moved so as to move forward the support block 8 from the slot of the rack 11 to a predetermined position of

the holding table 10 while guided by the rails 10c. Conversely, when the holding table 10 with the support table 8 thereon is faced to a vacant slot of the rack 11, the piston rod 13a is backward moved and then the support block 8 is moved from the predetermined position of the holding table 10 while guided by the rails 10c to the vacant slot of the rack. Then, the support block 8 is stored in the slot, the piston rod 13a of the cylinder 13 is counterclockwise rotated from the engaging position to the removal position and then, the positioning pins 8a of the support block 8 are removed from and disengaged from the holes 13c of the rotatable plate 13b.

Another example of the claim part 12 is shown by 12a in Fig. 4B. In Fig. 4B, the cylinder 13 has a U-shaped rod piston 13e and a T-shaped clamp portion 13f at its end. The support block 8 has a T-shaped recess 8b into which the T-shaped clamp portion 13f can be engaged. Thus, when the support block 8 is moved from the slot of the rack 11 to the holding table 10, the U-shaped piston rod 13e is rotated to engage the T-shaped clamp portion 13f into the T-shaped recess 8b of the block support 8.

The apparatus further comprises a controller 100 for controlling the exchange of the support blocks 8, an input device 101 such as a key board for inputting instructions into the controller 100 therethrough, a

display 104 for displaying an error when the selected support block 8 is not stored in the rack 11, and sensors 102a, 102b, 102c, and 102d, located at slots of the rack 11, for detecting presence of the support block 8 at each slot in the rack 11 to input such information into the controller 100. The controller 100 is connected to the input device 101, the display 104, the sensors 102a-102d, the motor 9, the cylinder 13, and the board detection sensor 90 so that the controller 100 controls operations of the cylinder 13 and the motor 9 based on the input information from the input device 101, the sensors 102a-102d, and the board detection sensor 90. Reference numeral 110 denotes a pair of stoppers for positioning the support block 8 at the predetermined position on the holding table 10 by contacting the side surface of the support block 8 with the stoppers 110.

Instead of the provision of the sensors 102a-102d, there can be provided a sensor 103, located at the side surface of the support block holding table 10 which faces to the slots of the rack 11 so as to detect presence of the support block 8 at each slot of the rack 11. In this case, when the support block holding table 10 moves downward and upward, the sensor 103 detects the presence of the support block 8 at each slot of the rack 11 to input such information into the controller 100.

First, a board 5 where the electronic component is to be mounted is transferred by the transfer belt device 6 to above the support block 8 having the plurality of support pins 7. At this time, when it is detected by the board detection sensor 90 or the like that the board 5 reaches a predetermined position above the support block 8, the holding table 10 is raised to a predetermined position by the motor 9 based on the control operation of the controller 100 to hold the board 5 on the support pins 7 of the support block 8. Then, the electronic components are mounted on the board 5 held by the support block 8, and, upon completion of the mounting, based on the control operation of the controller 100, the holding table 10 is lowered to a predetermined position by the motor 9. The board 5 having the mounted electronic components is taken out by the transfer belt device 6.

An exchange operation for support blocks 8 correspondingly to the switching of the kind of boards 5 will be discussed below, based on the control operation of the controller 100. When the kind of boards 5 is changed, the support block 8 should match the switched board 5, that is, the support pins 7 on the support block 8 should be arranged to conform to the switched board 5. The storing rack 11 stores the support blocks 8 corresponding to a plurality of kinds of boards 5. In order to exchange the

support blocks 8, the holding table 10 is positioned by the motor 9 to a vacant slot in the storing rack 11, and the support block 8 currently used is clamped by the clamp part 12 arranged over the holding table 10 and accommodated in the vacant slot of the rack 11 by the cylinder 13 as described above. After the support block 8 is accommodated therein, the clamp part 12 is released and the holding table 10 is positioned by the motor 9 to a position of the support block 8 to be used next in the rack 11. The support block 8 to be used next is clamped by the clamp part 12 and set at the predetermined position on the holding table 10 by the cylinder 13. The holding table 10 after exchanging the support blocks 8 is raised again by the motor 9, when the exchange operation is finished.

The support blocks 8 can be automatically exchanged if the support blocks 8 corresponding to the kinds of boards 5 are preliminarily designated and input in mounting programs stored in the controller 100 of the apparatus. The mounting program corresponding to the kind of boards 5 is selected, thereby to automatically select and exchange the corresponding support block 8. The exchange operation may be also carried out simply through the input device 101 such as a key input, without inputting of mounting programs.

That is, in such a case, the electronic component mounting method according to the embodiment is executed in accordance with the flow chart shown in Fig. 3. First, at step S1, is input into the controller 100 through the input device 100, data of indicating relationship between the kinds of boards 5 and the support blocks 8 corresponding to the kinds of boards 5. At step S2, by the controller 100, one of support blocks 8 in correspondence with a kind of board 5 to be supported is selected based on the input data indicating the relationship. At step S3, it is decided by the controller 100 whether or not the selected support block 8 is stored in the rack 11. If the selected support block 8 is not stored in the rack 11, an error is displayed on the display 104 at step S5. When the selected support block 8 is stored in the rack 11, the moving amount of the holding table 10 is determined in accordance with the number of the slot where the selected support block 8 is stored in the rack 11 and the number of a vacant slot where the support block 8 placed on the holding table 10 will be stored. At step S4, the holding table 10 is driven by the motor 9 based on the determined moving amount and the present support block 8 on the holding table 10 is faced to the vacant slot of the rack 11 to move the support block 11 into the vacant slot. Then, the holding table 10 is moved to face the selected support block 8 stored in the slot of

the rack 11 and the selected support block 8 is taken out from the slot.

As is described hereinabove, in the electronic component mounting apparatus according to the embodiment of the present invention, the plurality of support blocks for supporting the boards when mounting the electronic components, etc. thereon are provided. The support block corresponding to the kind of boards is automatically selected among the plurality of support blocks when the kind of boards is changed. Accordingly, the switching time for switching the kind of boards is reduced and the working efficiency of facilities is enhanced, thus improving the productivity to mount the electronic components. The plurality of support blocks provided in the electronic component mounting apparatus are stored in the storing device set at one side of the support block moving device. When the support blocks are to be exchanged, the using support block is stored in a vacant slot of the storing device, and the support block to be used next is fed from the storing device. In the electronic component mounting apparatus, the support block is moved up and down to mount the electronic components by the same driving device as used when the support block is moved up and down to be exchanged. The up-and-down movement of the support block when the electronic components are mounted on the board is

carried out by the same driving motor as when the support block is moved up and down to be exchanged. The construction of the driving devices can be simplified.

The electronic component mounting apparatus can include a process for inputting data of the support blocks corresponding to the kinds of boards to be produced, a process for selecting the corresponding support block based on the input data, and a process for exchanging the present support block with the selected support block, whereby the required support block can be automatically exchanged on the basis of the selection of a mounting program corresponding to the kind of boards.

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.



WHAT IS CLAIMED IS:

1. An electronic component mounting apparatus comprising:

a plurality of support blocks (8) one of which supports a board (5) when mounting an electronic component, wherein a support block among the plurality of support blocks is automatically selected and exchanged in accordance with switching of a kind of boards.

2. An electronic component mounting apparatus according to claim 1, further comprising:

a storing device (11) for storing the plurality of support blocks; and

a support block moving device (9, 9a, 9b, 9c, 9d, 10, 12, 13) for selecting one of the support blocks stored in the storing device in accordance with the switching of the kind of boards and moving the selected support block from the storing device to a position where the board is supported by the selected support block.

3. An electronic component mounting apparatus according to claim 1, further comprising a single support block driving device for upward moving the support block to support the board when the electronic component is mounted on the board, downward moving the support block to stop supporting the board, and exchanging the support block with another support block.



4. An electronic component mounting apparatus according to claim 2, wherein the support block moving device upward moves the support block to support the board when the electronic component is mounted on the board, and downward moves the support block to stop supporting the board.

5. An electronic component mounting method comprising:

selecting one of support blocks in correspondence with a kind of board to be supported, based on data indicating relationship between kinds of boards (5) and the support blocks corresponding to the kinds of boards; and

exchanging a present support block with the selected support block.

6. An electronic component mounting method according to claim 5, further comprising, before selecting the support block, inputting the data of indicating the relationship between the kinds of boards (5) and the support blocks corresponding to the kinds of boards.

7. An electronic component mounting method according to claim 5, further comprising displaying an error when the selected support block in selecting the support block is not stored in a support block storing device (11) for storing the support blocks to be exchanged in exchanging the support block.



8. An electronic component mounting method according to claim 6, further comprising displaying an error when the selected support block in selecting the support block is not stored in a support block storing device (11) for storing the support blocks to be exchanged in exchanging the support block.

9. An electronic component mounting apparatus according to claim 1, wherein the support blocks are different in positions of pins (7) for supporting the boards.

10. An electronic component mounting apparatus according to claim 2, wherein the support blocks are different in positions of pins (7) for supporting the boards.

11. An electronic component mounting method according to claim 5, wherein the support blocks are different in positions of pins (7) for supporting the boards.

12. An electronic component mounting method according to claim 6, wherein the support blocks are different in positions of pins (7) for supporting the boards.