# DESCRIPTION

## APPARATUS FOR FEEDING ELECTRONIC COMPONENT AND METHOD FOR MOUNTING ELECTRONIC COMPONENT

### TECHNICAL FIELD

The present invention relates to an electronic component-feeding apparatus and an electronic component mount method used in mounting electronic components to circuit boards.

### BACKGROUND ART

Fig. 3 is a diagram showing a constitution of a conventional electronic component-mounting apparatus. A component storage section 3 storing required electronic components 2 is selected from a component storage device 1 loading several tens of component storage sections 3, and sent out in a direction of an arrow I. A mounting head 10 moving freely in X-axis and Y-axis directions sucks thereby holding to transfer the electronic components 2. A sucked position of the electronic component 2 is first detected by a position detection camera 7, and thereafter an accuracy of clinched leads of the component, or the like is inspected by a good/defective component inspecting device 6. Whether the electronic component 2 is good or fails is thus inspected and if the electronic component 2 is defective,

the electronic component 2 is removed. A suction attitude and a mount position of the electronic component 2 judged to be good are corrected on the basis of information of the sucked position obtained by the position detection camera 7. The electronic component 2 is mounted to a circuit board 11 then. A plurality of tape-type component feeding devices 12 feeding components stored in a tape, etc. are arranged at an opposite side of the component storage device 1 via a transfer path for the circuit board 11, so that the other components to be mounted to the circuit board 11 are properly supplied and mounted to the circuit board 11 with the use of the aforementioned mounting head 10.

In the prior art constitution as above, a sequence of processes takes time, i.e., a process wherein the component storage device selects the required component storage section, moves the storage section up/down and sends out the storage section through a take-out opening, a process wherein a transfer head sucks thereby holding and transfers the predetermined electronic component, a process wherein the sucked position of the component is detected and corrected, thereby inspecting whether the component is good or defective, and a process of mounting the component to the circuit board. Productivity is yet to be solved.

The present invention has for its object to provide an electronic component-feeding apparatus and an

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electronic component mount method of improved efficiency.

DISCLOSURE OF INVENTION

In solving the above-discussed disadvantage, according to a first aspect of the present invention, there is provided an electronic component-feeding apparatus which comprises:

component storage sections storing electronic components;

a component storage device having a plurality of the component storage sections therein, and selecting and sending out a desired component storage section therefrom;

a transfer head having a suction nozzle for sucking a predetermined electronic component from the component storage section selected and sent out by the component storage device thereby transferring the predetermined electronic component to a component alignment section; and

the component alignment section holding the electronic components sequentially transferred by the transfer head, and transferring the held electronic components sequentially to a suction position of a mounting head. By the above construction of the aspect of the present invention, the electronic components can be aligned in the order of mounting at the component alignment section with the utilization of a time while a circuit board is

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carried in or discharged, so that the electronic components are efficiently supplied to the mounting head when the electronic components are mounted to the circuit board. Thus, efficiency in mounting the electronic components is improved greatly.

According to a second aspect of the present invention, an inspecting device is added to the electronic component-feeding apparatus of the first aspect of the present invention for inspecting whether the electronic component on a transfer path of the transfer head is good or defective. By the above construction, in addition to the aforementioned effect realized by the first aspect of the present invention, the electronic components can be inspected before supplied to the mounting head. So, efficiency is furthermore enhanced.

According to a third aspect of the present invention, the component alignment section of the first or second aspect of the present invention includes a component alignment belt, and alignment suction nozzles arranged on the component alignment belt in a row via a constant distance along a transfer direction of the component alignment belt, whereby the electronic components are sequentially supplied to the mounting head through an intermittent operation of the component alignment belt. By the above construction, the electronic components can

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accordingly be efficiently and surely supplied to the mounting head in a state while aligned in the order of mounting.

According to a fourth aspect of the present invention, in the electronic component-feeding apparatus in any one of the first-third aspects of the present invention, the transfer direction of the component alignment belt of the component alignment section is oriented in parallel to a direction in which the selected component storage section is sent out from the component storage device, and the transfer head moves in a direction orthogonal to the send-out direction. By the above constructions, the electronic components can be aligned on the component alignment section efficiently in the order of mounting through a reciprocatory operation of the transfer head.

According to a fifth aspect of the present invention, there is provided a method for mounting electronic components to a circuit board, which comprises:

selecting and sending out a required component storage section by a component storage device which holds therein a plurality of the component storage sections storing the electronic components;

repeating operations in which a transfer head takes out a predetermined electronic component in the component storage section selected and sent out by the

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component storage device, and transfers the predetermined electronic component to a component alignment section, and delivers the electronic component on the component alignment section;

holding the electronic component sequentially transferred by the transfer head and supplying the held electronic component to a suction position of a mounting head by the component alignment section; and

sucking the electronic component on the component alignment section sequentially by the mounting head and mounting the sucked electronic component to the circuit board. By the above constructions, the electronic components can be efficiently supplied to the mounting head in a state while aligned in the order of mounting, with the utilization of a time required for carrying in and out the circuit board, etc. In consequence, the electronic components are mounted efficiently to the circuit board.

According to a sixth aspect of the present invention, in the middle of the transfer of the electronic components by the transfer head to the component alignment section in the invention of the fifth aspect, an inspecting device inspects whether the electronic component is good or defective. That is, whether or not the electronic component is good is inspected before supplied to the mounting head, thereby enhancing efficiency.

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As described hereinabove, in the electronic component-feeding apparatus and the electronic component mount method provided according to the present invention, the time when the circuit board is carried in or out, etc. is efficiently utilized to feed the electronic components to the mounting head in a state while the electronic components are aligned in the order of mounting. A mount time for the electronic components in a mount process is consequently greatly reduced, and productivity is expected to be improved. Moreover, the good/defective inspection of the electronic components can be accomplished before aligned in the order of mounting, achieving further improvement in efficiency.

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:

Fig. 1 is a perspective view of an electronic component-feeding apparatus in an embodiment of the present invention;

Fig. 2 is a diagram of the constitution of an electronic component-mounting apparatus according to an embodiment of the present invention which includes the

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electronic component-feeding apparatus of Fig. 1; and

Fig. 3 is a diagram of the constitution of a conventional electronic component-mounting apparatus.

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.

Preferred embodiments of the present invention will be described hereinbelow with reference to Figs. 1 and 2 in which the same members as in the conventional art are designated by the same reference numerals.

In Fig. 1, a component storage device 1 holds several tens of component storage sections 3 such as trays or the like storing electronic components 2 therein. The layered storage sections 3 are held in the device 1 in a manner to be movable up and down. The component storage section 3 storing a required electronic component is designated according to a program, and then is moved up and down and carried to a take-out opening 15 by moving up and down a component storage section-supporting shelf 14 supporting the component storage section 3. The component storage section 3 is discharged out in a direction of an arrow I through the take-out opening 15. A transfer head 4 having several kinds of transfer suction nozzles 5 takes

out the electronic component 2 from the component storage section 3 with the use of an optimum nozzle conforming to a type of the electronic component 2, transfers the electronic component in a direction of an arrow II along a guide rail 16 and passes the electronic component over a good/defective component-inspecting device 6 arranged at a location corresponding to a transfer path of the electronic component to inspect a good/defective of the electronic component. The electronic component 2 is moved to a component alignment section 13 when the component is good, whereas the defective electronic component 2 is eliminated by a removing means (not shown in the drawing). The good/defective component-inspecting device 6 scans the electronic component 2 with laser light in a direction orthogonal to the arrow direction II when the electronic component 2 transferred in the direction II passes over the inspecting device 6, thereby carrying out inspections on the following inspection items on the basis of a light-receptive position and a light-receptive amount of a reflected laser light of the scan. The inspection items referred to above are a lead pitch, a lead count, a lead bend in a thicknesswise direction of the electronic component, etc. in the case of the electronic component 2 having leads. For the electronic component 2 with solder balls or bumps, the inspection items are a lack or break, a

height and a shape of the solder ball or bump. Inspection information from the inspecting device 6 is supplied to a control device 18 which judges whether the electronic component 2 is good or defective.

The component alignment section 13 has two component alignment belts 8. A plurality of alignment suction nozzles 9 are arranged via a constant distance on each component alignment belt 8. So, the component alignment section 13 sends the electronic components 2 to suction positions P1, P2 of a mounting head 10 sequentially through an intermittent driving via a constant pitch by the alignment belts 8. A suction device 17 is connected to each component alignment belt 8. The alignment suction nozzles 9 suck thereby holding the electronic components 2 by the suction device 17.

The control device 18 controls the above-described operations of at least the component storage device 1, transfer head 4, good/defective component-inspecting device 6, mounting head 10, component alignment section 13 and suction device 17. The control device 18 can also control operations of a position detection camera 7 and a transference of the circuit board 11 as described later. A mount program recording in the order of mounting a relationship of mount positions on the circuit board and types of the electronic components to be mounted at the

mount positions, and information related to a mount operation such as types of the electronic components stored in the component storage sections 3, etc. are stored in the control device 18 before the mounting is started.

Fig. 2 is a diagram showing the constitution of an electronic component-mounting apparatus in an embodiment of the present invention including the electronic component-feeding apparatus. 12 is a component feeding apparatus in a tape-type or stick-type. The component storage device 1 is set at the opposite side to the feeding apparatus 12 via a circuit board feed path 21. The component alignment section 13 is arranged in parallel to the component storage device 1, and the good/defective component-inspecting device 6 is positioned between the component storage section 3 and the component alignment belt 8. The position detection camera 7 for correction of the component sucked position is placed between the component alignment belts 8 and circuit board 11.

With the utilization of a time while the circuit board 11 after the component is mounted thereto is moved out and a fresh circuit board 11 is carried in, or while the mounting head 10 mounts a different electronic component supplied from the tape-type or stick-type component feeding apparatus 12 to the circuit board 11, the transfer head 4 takes out an electronic component 2 from

the component storage section 3, the electronic component 2 is inspected by the good/defective component-inspecting device 6 installed in the middle of the transfer path, and then if the electronic component 2 is good, the transfer head 4 handles the electronic component 2 to the alignment suction nozzle 9 on the alignment belt 8. The above operation is repeatedly carried out for a predetermined number of times, thereby after the inspection, the electronic components 2 can be aligned sequentially on the component alignment belts 8 in the programmed order of mounting, and sucked and held by the alignment suction nozzles 9. Through the intermittent feeding by the component alignment belts 8, the electronic components 2 are sent towards the mounting head 10 by every one pitch. In the constitution, a time for carrying in and out the circuit board 11, etc. can be utilized efficiently and, the mounting head 10 merely reciprocates between a leading end of the alignment belts 8 at the side of the mounting head 10 and the circuit board 11, whereby an increase in speed of the mounting operation is achieved.

According to the above arrangement, even in the case of electronic components of a large size requiring the component storage device having trays layered therein, a predetermined electronic component can be taken out, transferred and mounted in short time, so that the large

electronic components can be supplied efficiently in the same manner as in the tape-type or stick-type component feeding apparatus.

Although the component alignment section uses two component alignment belts in the above description, one component alignment belt or two or more belts can act in the same way.

In the embodiment, the good/defective component inspecting device is located between the component storage device and component alignment belt. However, the arrangement is not specified, for instance, the inspecting device may be set at the component alignment section.

Further, the tape-type or stick-type component feeding apparatus is employed together in the embodiment, but the electronic component-feeding apparatus of the present invention may be used singly in the electronic component-mounting apparatus, which fulfills the same effect.

The mounting head adopted in the embodiment moves in the X-axis and Y-axis directions. Other kinds of mounting heads, e.g., a rotary head and the like are applicable to the electronic component-feeding apparatus of the present invention.

The entire disclosure of Japanese Patent Application No. 8-217177 filed on August 19, 1996 including

the specification, claims, drawings and summary is 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.

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CLAIMS

1. An electronic component-feeding apparatus which comprises:

component storage sections (3) storing electronic components;

a component storage device (1) having a plurality of the component storage sections therein, and selecting and sending out a desired component storage section therefrom;

a transfer head (4) having a suction nozzle (5) for sucking a predetermined electronic component from the component storage section selected and sent out by the component storage device thereby transferring the predetermined electronic component to a component alignment section (13); and

the component alignment section (13) holding the electronic components sequentially transferred by the transfer head, and transferring the held electronic components sequentially to a suction position of a mounting head (10).

2. The electronic component-feeding apparatus according to claim 1, which further includes an inspecting device (6) for inspecting whether the electronic component is good or defective on an electronic component transfer path of the transfer head.

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3. The electronic component-feeding apparatus according to claim 1 or 2, in which the component alignment section comprises a component alignment belt (8) and alignment suction nozzles (9) arranged in a row via a constant distance on the component alignment belt along a transfer direction of the component alignment belt, thereby supplying the electronic components sequentially to the mounting head through an intermittent operation of the component alignment belt.

4. The electronic component-feeding apparatus according to any one of claims 1-3, wherein the transfer direction of the component alignment belt of the component alignment section is oriented in parallel to a direction in which the selected component storage section is sent out from the component storage device, and the transfer head moves in a direction orthogonal to the send-out direction.

5. The electronic component-feeding apparatus according to any one of claims 1-4, wherein the component storage section is a tray storing the electronic components in each section divided in lattice.

6. A method for mounting electronic components to a circuit board, which comprises:

selecting and sending out a required component storage section (3) by a component storage device (1) which holds therein a plurality of the component storage sections

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storing the electronic components;

repeating operations in which a transfer head (4) takes out a predetermined electronic component in the component storage section selected and sent out by the component storage device, and transfers the predetermined electronic component to a component alignment section (13), and delivers the electronic component on the component alignment section;

holding the electronic component sequentially transferred by the transfer head and supplying the held electronic component to a suction position of a mounting head (10) by the component alignment section; and

sucking the electronic component on the component alignment section sequentially by the mounting head and mounting the sucked electronic component to the circuit board.

7. The electronic component mount method according to claim 6, wherein whether the electronic component is good or defective is inspected by an inspecting device in a middle of the transfer by the transfer head to the component alignment section.

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