

Component face-reversing feeder

The present invention relates to a component face-reversing feeder, which is used, for example, for mounting an electronic component onto a substrate such that the component
5 on a tray or an expanded sheet is picked up by a suction nozzle which is then turned around 180-degree so as to reverse the face of the picked-up component before mounting it onto the substrate.

In recent years, flip-chip mounting has become a main
10 stream in the field of semiconductor mounting technology as the miniaturization of a circuit board has been progressing as represented by a multi-chip module or a chip-size package.

An apparatus for flip-chip mounting is constructed such as shown in Fig. 3, in which an integrated circuit (IC) chip
15 102 located on a tray 101 or an expanded sheet with its circuit face upward is picked up by a suction nozzle 103, which is then rotated 180-degree so as to turn over the IC chip 102 before feeding it to a bonding head 104 which mounts the chip onto a circuit board (not shown).

20 The bonding head 104 attracts the IC chip 102 which has been reversed to have its circuit face downward, transfers it to a mounting position and mounts it on a prescribed location on the circuit board with the circuit surface of the chip

facing down. The IC chip is then mounted to the circuit board by connecting elements on the circuit surface of the chip and a conductive pattern on the circuit board by soldering or similar.

5 The apparatus shown in Fig. 3 is capable of positioning the tray 101 at a desired location in Y direction, and for that purpose it is provided with a moving robot 105 for driving the tray 101 in the Y direction. In addition, the apparatus includes another moving robot 106 for causing the
10 suction nozzle 103 to move in X direction which is orthogonal to the Y direction, so that the nozzle 103 can be positioned at a necessary location in the X direction. With this arrangement, an IC chip 102, wherever it is located on the tray 101, can be brought to confront a predetermined suction
15 nozzle 103 and be picked up. The state of the IC chip being positioned is monitored by a recognition camera 107. The suction nozzle 103 moves upward and downward for the action of picking up the IC chip 102, and such movement of the nozzle 103 is effected by a vertical motion mechanism 108
20 mounted on the moving robot 106.

For the purpose of reversing the face of the IC chip, the suction nozzle 103 is supported by a turning mechanism 117 which is mounted on the vertical motion mechanism 108 and

has its turning center line Q which is orthogonal to a plane including an axis line P of the suction nozzle 103, so that a suction nozzle 103 facing down which has picked up an IC chip 102 can be rotated 180-degree around the turning center line Q and be faced upward.

However, in the above-described component face-reversing feeder, the suction nozzle 103 picks up the IC chip 102 even when the IC chip 102 is displaced around the axial line P of the suction nozzle 103. There is thus such a possibility that the suction surface of the nozzle 103 hits the circuit surface of the IC chip 102 at its one edge, resulting in a flaw or damage on the circuit face of the IC chip 102.

An object of the present invention is to provide a component face-reversing feeder which is capable of attracting and picking up components with a suction nozzle without causing any problems even when a target component is shifted at an angle around the axis line of the suction nozzle.

In order to achieve the above object, according to a first aspect of the present invention, in a component face-reversing feeder which picks up a component disposed in a row from above with a suction nozzle and turns over the suction

nozzle upwards by rotating it 180-degree so as to feed the component of which face has been thereby turned over, the improvement comprises: a rotary mechanism mounted on a turning mechanism which causes the suction nozzle to turn, by
5 which the suction nozzle is rotated around an axis line thereof; a detector which detects an angle of rotation of the component around the axis line of the suction nozzle which is going to pick up the component; and a controller for controlling the rotary mechanism such as to cause the suction
10 nozzle to rotate at a necessary angle around the axis line thereof before picking up the component according to a detection result.

With such an arrangement, since an angle of rotation of the component which is picked up next is detected by the
15 detector, and the controller controls such that the rotation mechanism causes the suction nozzle to rotate at a necessary angle in accordance with the detection result, the suction nozzle can always pick up the component which is exactly opposite to the nozzle in terms of its posture around the
20 axis line of the suction nozzle. The suction nozzle is thus prevented from hitting against the surface of the component at its one side which may cause a chip or a flaw on the component.

It is possible, as in a second aspect of the present invention, to mount on the turning mechanism a plurality of suction nozzles disposed radially around a turning center line of the turning mechanism. Component pick-up operation
5 can be thereby efficiently carried out by successively using the plurality of suction nozzles. Alternatively, the plurality of suction nozzles may be separately used corresponding to different kinds of components so as to appropriately deal with various types of components.

10 These and other objects, features and advantages of the present invention will be apparent from the following description of the preferred embodiments of the invention in conjunction with the accompanying drawings, in which:

Fig. 1A is a front view and Fig. 1B is a side view with
15 a partial cross-sectional view of a primary part, both showing an overall construction of a component face-reversing feeder according to one embodiment of the present invention;

Fig. 2A is a front view and Fig. 2B is a side view with
a partial cross-sectional view of a primary part, both
20 showing an overall construction of a component face-reversing feeder according to another embodiment of the present invention; and

Fig. 3 is a perspective view showing an overall

structure of a conventional component face-reversing feeder.

Preferred embodiments of the present invention will be described below with reference to Figs. 1A, 1B and Figs. 2A, 2B.

5 (First Embodiment)

In a first embodiment, similarly with the conventional apparatus of Fig. 3, an IC chip 2 located on a tray 1 or an expanded sheet with its circuit face upward is picked up by a suction nozzle 3, which is then rotated 180-degree so as to
10 turn over the IC chip 2 before it is fed to a bonding head 4 which mounts the chip onto a circuit board (not shown).

The schematic construction of the apparatus is, as shown in Figs. 1A and 1B, such that the tray 1 can be positioned at a desired location in Y direction with a moving
15 robot 5 for driving the tray 1 in the Y direction, and that the suction nozzle 3 can be positioned at any location in X direction which is orthogonal to Y direction with another moving robot 6 for causing the suction nozzle 3 to move in X direction. Each of the moving robots 5, 6 may be, for example,
20 constructed with a Y-direction moving body 11 and an X-direction moving body 12, respectively, for supporting the tray 1 and the suction nozzle 3 such as to be movable in Y or X direction, and a screw shaft which is driven by a servo

motor for causing these Y-direction moving body 11 and X-direction moving body 12 to move to a prescribed location in Y or X direction. With this arrangement, an IC chip 2, wherever it is located on the tray 1, can be brought to
5 confront a predetermined suction nozzle 3 and be picked up. The state of the IC chip 2 being positioned is monitored by a recognition camera 7.

Any of other various known mechanisms may be employed for such positioning. Specific illustration and description
10 of such mechanisms are omitted as they are already known.

The picking-up of the IC chip 2 is achieved by vertical motions of the suction nozzle 3 which is effected by a vertical motion mechanism 8 mounted on the X-direction moving body 12 of the moving robot 6. The vertical motion mechanism
15 8 comprises a vertical motion body 9 supported via a vertical guide 13 on the X-direction moving body 12 for upward and downward movements, a cam 15 driven by a servo-motor 14 mounted on the X-direction moving body 12, and a cam follower 16 provided to the vertical motion body 9 such as to follow
20 the movement of the cam 15. With this arrangement, when the cam 15 is driven to rotate by the servo motor 14, the vertical motion body 9 is moved upward and downward together with the suction nozzle 3 following the movement of the cam

15 via the cam follower 16, so that, when the nozzle 3 is descended above a target IC chip 2, it attracts the chip after which the nozzle is ascended to pick up the IC chip 2 from the tray 1.

5 The mechanism for vertical movements of the suction nozzle 3 is not limited to the one described above, and various other known arts may be employed.

For the purpose of turning over the IC chip 2, the suction nozzle 3 is supported by a turning mechanism 17 which
10 is mounted on the vertical motion body 9 and has a turning center line B which is orthogonal to the axis line A of the suction nozzle 3, and is constructed such as to be rotated 180-degree around the turning center line B, so that the nozzle 3 facing down as shown in Fig. 1 and holding the
15 picked-up chip 2 is turned 180-degree to face upwards. The turning mechanism 17 retains the suction nozzle 3 with its turning body 21 supported on the vertical motion body 9 such as to be rotatable around the turning center line B. Face reversing action of the IC chip 2 is performed such that the
20 rotation of a pulley 23 driven by a servo motor 22 provided to the vertical motion body 9 is transmitted via a belt 24 to another pulley 25 which is coaxially mounted around the turning center line B and integrally mounted on the turning

body 21, by which the turning body 21 is rotated every 180-degree around the turning center line B in one or both directions. However, the turning mechanism is not limited to the one described above, and various other known arts may be employed. By employing the servo motor 22 of a one-directional rotary type, the mechanism may be constructed with an induction motor having a dog provided with a slit every 180 degrees and a sensor for detecting the slit or a high rotor, since the actuator is required only to be stopped every 180-degree rotation.

Specifically in this embodiment, a rotary mechanism 31 for causing the suction nozzle 3 to rotate around its axis line A on the turning body 21 of the turning mechanism 17 for revolving the suction nozzle 3 and a controller 32 consisting of various controlling circuits such as a CPU for controlling the rotary mechanism 31 are provided. The rotary mechanism 31 is controlled such as to cause the suction nozzle 3 to rotate around the axis line A at a necessary angle before picking up an IC chip in accordance with an angle of rotation of the IC chip to be picked up next around the axis line A of the suction nozzle 3, which is detected by a detector for which the recognition camera 7 may be used in common.

The rotary mechanism 31 is constructed with a ball nut

34 of which rotating movement is held in the turning body 21 by a linear guide 33, a ball screw 35 which is coupled with the ball nut 34 and is integrally extended from the suction nozzle 3, a cam 36 mounted to the turning body 21 which
5 rotates around a rotating center line C orthogonal to the axis line A of the suction nozzle 3, a servo motor 37 for driving the cam 36, and a cam follower 38 mounted to the ball nut 34 such as to follow the movement of the cam 36.

However, the rotary mechanism 31 is not limited to the
10 one described above, and various other known arts may be employed.

In action, the state of an IC chip to be picked up next, i.e., a rotation angle around the axis line A of the suction nozzle 3 which is going to attract and pick up this chip is
15 detected by image recognition using the camera 7. The detection result is compared with the configuration of the suction nozzle 3 or other factors, and if they do not correspond with each other, the controller 32 causes the cam 36 to rotate in accordance with the amount of displacement of
20 the chip by the servo motor 37 before the suction nozzle 3 attracts the IC chip 2.

When the cam 36 is rotated, the ball nut 34 is vertically moved via the cam follower 38 since it is held

with the linear guide 33, and causes the ball screw 35 or the suction nozzle 3 to rotate either clockwise or counterclockwise in accordance with the amount of its vertical movement. Accordingly, the orientation of the IC chip 2 with respect to the suction nozzle 3 which is going to pick it up next is adjusted correspondingly with the suction nozzle 3. Therefore, the suction nozzle 3 picks up IC chip 2 of which posture around the axial line A of the nozzle 3 is always correspondent with that of the suction nozzle 3, whereby it is prevented that the suction surface of the nozzle 3 hits the circuit surface of the component and causes a flaw or chip on the component.

(Second Embodiment)

In a second embodiment, as shown in Figs. 2A and 2B, the turning mechanism 17 is mounted with a plurality of suction nozzles 3 radially disposed around the turning center line B so that the picking-up of the IC chip 2 can be achieved with less dead time by successively using the plurality of suction nozzles 3. Such plurality of nozzles 3 can also be separately used corresponding to types of components, so that various kinds of electronic components can be appropriately handled and fed. Other structures and effects are substantially identical to those of the first

embodiment. Thus, like elements are given the same reference numerals and the description thereof will be omitted.

More specifically, four suction nozzles 3 are mounted to the turning body 21, all of the nozzles 3 being different
5 corresponding to four kinds of IC chips 2 accommodated respectively on four trays 1 which are fed by the moving robot 5.

By this arrangement, it is possible to deal with multiplicity of types of components in addition to the
10 characteristics of the first embodiment.

Although the first and second embodiments have been described in relation to the case of feeding an IC chip 2, the present invention is not limited thereto and may be applied to a feeding operation of various other components
15 which need to be fed with their face reversed for various treatments.



CLAIMS

1. In a component face-reversing feeder which picks up a component (2) arranged in a row from above with a suction nozzle (3) and turns over the suction nozzle (3) upwards by 180-degree rotation so as to feed the component (2) of which face has been thereby turned over, characterized by:

a rotary mechanism (31) mounted on a turning mechanism (17) which causes the suction nozzle (3) to turn, by which the suction nozzle (3) is rotated around an axis line (A) thereof;

a detector (7) which detects an angle of displacement of the component (2) around the axis line (A) of the suction nozzle (3) which is going to pick up the component (2); and a controller (32) for controlling the rotary mechanism (31) such as to cause the suction nozzle (3) to rotate at a necessary angle around the axis line (A) thereof before picking up the component (2) according to a detection result.

2. The component face-reversing feeder according to claim 1, wherein the turning mechanism (17) is mounted with a plurality of suction nozzles (3) disposed radially around a turning center line (B) of the turning mechanism (17).

