Description

Method of, and device for, fitting components on substrates

The invention relates to a method of, and a device for, fitting components on substrates. Arrangements for fitting electrical components on substrates, in particular printed circuit boards, have to be capable of compensating for different substrate thicknesses, deviations in the substrate geometry and different thicknesses of the components.

US 5 285 946 discloses, for this purpose, a device for fitting electronic components on the surface of printed circuit boards, in which a suction-tube tip is mounted resiliently as the retaining device. This resilient mounting achieves the situation where, when the components are positioned on the substrate and/or when the suction tube is positioned on the component in a feed arrangement, the necessary contact pressure is achieved without the component being destroyed by an excessive pressure.

As the components are received from feed arrangements, these springs subject the component to pronounced acceleration. The acceleration here may be large enough for the component to fall off the retaining device, for example a suction tube. Such component which are lost in this way results, on the one hand, on the component-fitting cycle having to be repeated and, on the other hand, in the lost components remaining in the machine, and this may produce errors during movement of the component-fitting heads or of the substrates.

The object of the invention is thus to specify a method of, and a device for, fitting components on substrates which ensure that the components are received reliably

and also ensure a sufficient contact pressure for the components on the substrate.

The object is achieved according to the invention by a method having the features of patent claim 1 and by a device having the features of patent claim 2.

Claim 1 here provides that the retaining device is coupled firmly to the component-fitting head at the moment at which it moves away from the feed arrangement, as a result of which the retaining device and thus also the component located on it are moved directly by the acceleration of the retaining device. At the moment at which the retaining device is positioned on the component, and at the moment at which the component is positioned on the substrate, at least that part of the retaining device which is directed toward the component is mounted resiliently in relation to the component-fitting head. This ensures that a sufficient contact pressure is provided without the component and/or the substrate being destroyed by excessive pressure.

In the case of the device as claimed in claim 2, means are provided in order, during acceleration of the retaining device in the direction away from the feed arrangement, at least to damp the action of the spring being relieved of stressing. This also ensures that the acceleration acting on the component is relatively low in relation to a free-swinging spring.

A particularly straightforward configuration of these means is produced, as claimed in claim 3, by shock absorbers which, during acceleration in the direction away from the feed arrangement, damp the action of the spring being relieved of stressing.

Provision is equally well made, as claimed in claim 4, for the means to be designed such that the acceleration

away from the feed arrangement acts directly on that region of the retaining device which is directed toward the component.

The device as claimed in claim 5 operates particularly reliably in that the means are designed as coupling elements which can be switched by a control unit and, in dependence on the position of the retaining device in each case, either couple the latter firmly to the component-fitting head (as the components are received) or decouple the retaining device from the component-fitting head. The retaining device is mounted resiliently when decoupled, with the result that the necessary contact pressure of the components on the substrate is achieved.

As claimed in claims 6 to 10, the switchable coupling elements may be realized by different principles, such as vacuum coupling, magnetic coupling, adhesion coupling or mechanical coupling.

The invention will be explained in more detail, by way of exemplary embodiments, with reference to the figures of the drawings, in which:

Figure 1 shows a side view of a retaining device before it fetches a component, the retaining device not being spring-deflected,

Figure 2 shows a side view of a retaining device once it has fetched a component,

Figure 3 shows a side view of a retaining device before it fetches a component, the coupling element not being activated, and

Figure 4 shows a side view of a retaining device, with the coupling element activated, once a component has been fetched,

Figure 5 shows a side view of a retaining device, with a shock absorber, before it fetches a component, and

Figure 6 shows a side view of a retaining device, with a shock absorber, once it has fetched a component.

Figure 1 illustrates schematically, in side view, a suction tube 1 as a retaining device before the latter fetches a component 2 from a feed arrangement 8 (not illustrated). The suction tube 1 retains the component by suction air.

Other retaining devices may retain components 2, for example, by adhesion forces. The suction tube 1 here is fastened on a component-fitting head 4 of an automatic component-fitting machine (not illustrated in anymore detail). At least that part of the suction tube 3 which is directed toward the component 2 is connected to the component-fitting head 4 here via a spring element. When the suction tube 1 is positioned on the component 2 the spring element 5 of the suction tube 1 achieves the situation where the contact pressure of the suction tube 1 on the component 2 does not exceed a defined predetermined value.

In the case of the process, illustrated in figure 2, of receiving the component 2 with the aid of the suction tube 1, the suction tube 1, including the part 3 directed toward the component 2, is coupled directly to the component-fitting head 4. As a result, the acceleration of the component-fitting head 4 acts directly on the component 2. This eliminates the adverse effect of the spring element 5 in this process. The acceleration of the component-fitting head 4 may thus be higher than in the case of utilizing a resilient part 5, without there being any risk of the components 2 falling off the suction tube 1 during the receiving process. This makes it possible to achieve a higher component-fitting capacity.

Figure 3 illustrates a further exemplary embodiment of a suction tube 1 in side view. In this case, that part of the suction tube 3 which is directed toward the component 2 is connected to the component-fitting head 4 by a spring 6. Also provided are switchable coupling elements 7, which are not active in that position of the suction tube which is illustrated in figure 3. If, then, the suction tube 1 is positioned on the component 2, a defined contact pressure is produced by the stressing of the string 6. As the component is received, the switchable coupling elements 7 are

activated, as a result of which the spring 6 remains in the compressed state, as is illustrated in figure 4. This means that it is only the acceleration of the component-fitting head 4 which acts on the component 2. As the acceleration of the component-fitting head 4 decreases,

the arrested formation 7 can then be released again. It is thus possible for the component then to be set down again in the desired remote position on the substrate, with defined contact pressure, under the influence of the spring 6.

The switchable coupling elements 7 may be realized here on the basis of different principles which are known per se, such as vacuum coupling, adhesion coupling, magnetic coupling or mechanical coupling. The mechanical coupling can be achieved, for example, via a piezo element.

Figure 5 illustrates a suction tube 1 with a shock absorber 9 which, as the suction tube 1 is set down on the component 2, damps the spring action of the spring 6, at most, to a very small extent.

As the component 2 is received from the feed arrangement 8 in the manner illustrated in figure 6, the shock absorber 9 achieves the situation where the spring 6 is only relieved of stressing with damping action, as a result of which the component 2 is subjected more or less to the acceleration by which the component-fitting head 4 is also accelerated. It is also the case in this exemplary embodiment that the damping of the spring action reduces the acceleration acting on the component 2.

The solution according to the invention makes it possible to operate the suction tubes with higher acceleration, as a result of which it is possible for more components to be received over the same period of time, and the component-fitting capacity of the automatic component-fitting machines increases correspondingly.

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Patent Claims

1. A method of fitting components (2) on substrates, in which
   - a retaining device (1), which is assigned to a component-fitting head (4), is lowered, under the stressing of a spring (5, 6), onto a component (2) located in a feed arrangements (8),
   - the component (2) is gripped by the retaining device (1),
   - when the retaining device (1) is raised, the action of the spring (5, 6) being relieved of stressing is prevented or at least damped,
   - the component-fitting head (4), with the retaining device (1), is displaced to a predetermined position above the substrate,
   - the component (2) is set down, under stressing of the spring (5, 6), on the substrate.

2. A device for fitting components (2) on substrates, having a component-fitting head (4) of at least one retaining device (1), of which at least the part (3), which is directed toward the component (2), is mounted resiliently in relation to the component-fitting head (4) by a spring (6), characterized in that means (e.g. 7) are provided in order the resilient mounting, during acceleration of the retaining device (1) in the direction away from a feed arrangement (8), to prevent or at least to damp the action of the spring (6) being relieved of stressing.

3. The device for fitting components (3) on substrates as claimed in claim 2, characterized in that the means are designed as shock absorbers (9) which, during acceleration in the direction away from the feed arrangement (8), damp the action of the spring (6) being relieved of stressing.

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4. The device for fitting components (2) on substrates as claimed in claim 2, characterized in that the means are designed such that the acceleration away from the feed arrangement (8) acts directly on that region of the retaining device (3) which is directed toward the component (2).

5. The device for fitting components (2) on substrates as claimed in claim 4, characterized in that the means are designed as coupling elements (7) which can be switched by a control unit and, during the acceleration away from the feed arrangement (8), couple that region of the retaining device (3) which is directed towards the component (2) firmly to the component-fitting head (4) and then decouple the same again.

6. The device for fitting components (2) on substrates as claimed in claim 5, characterized in that the operation of the switchable coupling elements (7) is based on vacuum coupling.

7. The device for fitting components (2) on substrates as claimed in claim 5, characterized in that the operation of the switchable coupling elements (7) is based on adhesion coupling.

8. The device for fitting components (2) on substrates as claimed in claim 5, characterized in that the operation of the switchable coupling elements (7) is based on magnetic coupling.

9. The device for fitting components (2) on substrates as claimed in claim 5, characterized

in that the operation of the switchable coupling elements (7) is based on mechanical coupling.

10. The device for fitting components (2) on substrates as claimed in claim 9, characterized in that the mechanical coupling is brought about by a piezo element.