Device for gripping and aligning an electronic component on a spindle

The present invention concerns a device for gripping and aligning on a gripping spindle an electronic component, notably an electronic component fitted with an integrated circuit and comprising a plurality of contact pins.

An electronic component such as mentioned is generally constituted of a housing of synthetic material enclosing the integrated circuit, a plurality of metallic contact pins spread protrudingly on at least one side of the housing and destined for the transmission of electronic signals towards and from the integrated circuit as well as for the fastening of said component by welding or any other means on a socket or a portion of a printed circuit card. Such a component is generally of small dimensions, on the order of some mm, and can thus be handled only with difficulty.

During one stage of the manufacturing process, generally at the end of the process, the component is tested electrically on an appropriate testing station. For this, the component, being maintained on a gripping spindle, is brought opposite a portion of said testing station, each of the component's contact pins being put into contact with a corresponding metallic track of the testing station, in order to verify the component's quality. In view of the aforementioned small dimensions of the component, this operation is very delicate.

A similar problem arises when the component must be fitted on a socket or a portion of a printed circuit card.

Generally for this the component, being placed on a first component gripping device, with an approximately known alignment relative to said gripping device, is gripped on the housing by means of a clamping device gripping two opposed sides of the housing which do not comprise contact pins, then the clamping device bearing the component is brought to the testing station where image recognition means and positioning means of the clamping device or testing device are generally used to align the component so that the contact pins arrive exactly opposite the corresponding

contact tracks of the testing station. Such a device is complicated and requires notably active means for adjusting the relative position of the clamping device and of the testing station according to at least two perpendicular axes as well as a rotational axis, as well as important computing means for the image recognition, notably in the case where several components are to be aligned simultaneously. Other devices propose to gather, by means of a stop, a position reference through a portion of the component's housing, for example a corner, a side or a polarization slot of the housing, then to align the component as soon as this reference is known. In addition to the active positioning means necessary as before, this device has the inconvenience of determining the position reference based on the housing, which can lead to a poor alignment of the contact pins in the case where these are slightly shifted relative to the housing. In all the cases where the component is gripped by a clamping device gripping two sides of the housing, the contact pins can hardly be reached in view of the clamp's bulk around said component.

Document EP-0.817.559 describes a gripping and aligning device quite similar to that proposed here, but for the fact that the component's aligning is effected by a vertical movement relative to a frame enclosing said component and fitted with oblique sides forming a sort of funnel. By this device, the alignment is achieved by acting in a direction where the mechanic resistance of the component's pins is at its weakest. Consequently, such a device generates a lot of waste.

Document US-4.860.439 describes a clamping device for aligning an electronic component of the PGA type. The jaws of the clamp having a small length, the risk of an extremity of a jaw being inserted between two pins of a component, with a damaging of said component, is not negligible.

A first object of the invention is to propose a device for gripping then aligning an electronic component on a gripping spindle which does not encounter the inconveniences of the known devices, and through which notably the component is aligned by taking directly as reference the position of the component's contact pins.

A second object of the invention is to propose a gripping and aligning device which comprises no active motorized positioning means

between the gripping spindle and the processing station of the component, which can be a testing station or a holding station, for the final adjusting of the position between these two elements.

These objects are achieved by a device for gripping and aligning an electronic component on a spindle, as described in the characterizing part of claim 1, alternative or specific embodiments being described in the dependent claims.

One preferred embodiment of a device according to the invention is described hereafter, this description having to be read in relation to the attached drawing containing the figures, in which:

Figure 1 shows a longitudinal sectional view of a spindle for gripping an electronic component in the gripping position of a component,

Figures 2A and 2B show a longitudinal sectional view of an aligning device in open position, respectively in closed position,

Figures 3A and 3B show the functioning of the jaws of the aligning devices of figures 2 A and 2B seen along line III-III of said figures, and

Figure 4 shows the same gripping spindle as that of figure 1 facing a component testing station.

Figure 1 shows a component 1, in this example a component of the type "dual in line" comprising contact pins only on two opposing sides of the housing, placed on a component holder 2 of any type, which can be part of a carrousel or of a production line of said component 1. A gripping spindle 3 is provided to grip component 1 on the component holder 2 to convey it towards an ulterior processing station. Gripping spindle 3 includes a supporting frame 30 comprising a traversing cylindrical boring 300. A mobile sleeve 31 is placed on the inside of the cylindrical boring 300 and fastened by a nut 32 screwed on a threading 310 of a first extremity of mobile sleeve 31, a face of said nut 32 being supported by an opposite side 301 of support 30. It can be seen in the figure that the external diameter of sleeve 31 is considerably smaller than the inner diameter of cylindrical boring 300, so as to

leave a gap between these two elements. Two O-ring type joints 302, placed in peripheral grooves provided on the sleeve 31 or in boring 300 laterally hold sleeve 31 in the boring 300. The extremity of sleeve 31 opposed to the one fitted with the nut 32, protruding out of the boring 300, comprises a support and positioning ring 311. A spring means, for example a coil spring 33 is supported on the one hand on the side of the support ring 311 facing support 30 and on the other hand on a shoulder 303 provided in boring 300. In this manner, the support ring 311 is maintained away from the side directly facing it of support 30. Support ring 311 further comprises guiding means 312 whose utility will be described below. A sliding tube 34 is placed inside another cylindrical boring 313 provided in sleeve 31. A first extremity of the sliding tube 34 is fixed by a spring 340 inside boring 313 whereas the other side of the sliding tube 34 slightly protrudes out of boring 313, respectively out of the lower side of sleeve 31, and forms the gripping extremity 344 of spindle 3. The constant of spring 340 is lower than the constant of spring 33.

The floating construction of spindle 3 just described makes it possible on the one hand for component 1 to be gripped and landed softly and, on the other hand, allows an adjusting of the position between spindle 3 and the testing or processing station which does not require any active displacement means. When support 30 is stationary, a slight mechanical pressure exerted on the protruding extremity of sliding tube 34 pushes said tube back into boring 313 by compressing the spring 340, by applying this pressure continuously, one thus compresses the spring 33, moving the support ring 311 closer to the lower side of support 30, at the same time lifting off nut 32 from side 301 of the support. At that moment, the sleeve 31 supporting the sliding tube 34 is supported only by spring 33 and the two O-ring type joints 302. Given the elasticity of these elements as well as the gap between the outer surface of sleeve 31 and the inner diameter of the cylindrical boring 300, it becomes possible to displace laterally the extremity of sleeve 31, respectively of the sliding tube 34, along the two perpendicular axes X and Y of a plane perpendicular to the longitudinal axis of the sleeve 31 as well as to slightly rotate said sleeve or said sliding tube around said longitudinal axis.

The gripping spindle 3 is complemented with a suction device comprising a blank feed attachment 35 fastened onto support 30. Said blank feed attachment being linked on the one hand to a suction unit, not

represented in the figure, and on the other hand to a first chamber 350 situated between the outer surface of sleeve 31 and the inner diameter of cylindrical boring 300, said chamber being limited longitudinally by the two O-ring type joints 302, ensuring the tightness of said chamber in addition to the support function of sleeve 31 described above. A radial communication is provided by the opening 314 arranged through the side of sleeve 31 which links a first chamber 350 to a second chamber 341 situated between sleeve 31 and the sliding tube 34, then by the opening 342 arranged through the side of the sliding tube and leads into the central suction hollow 343 of the suction tube. The central suction hollow 343 leads onto the gripping extremity 344 of the aspiration tube, protruding out of sleeve 31. The described conformation of the suction passage between the blank feed attachment 35 and the central suction hollow 343 allows for the passage of suction air whatever the relative longitudinal and angular positions between the different elements described.

In order to grip a component 1, as can be seen in figure 1, the spindle 3 is brought close to the component holder 2, so that the gripping extremity 344 of the suction tube is aligned according to the longitudinal axis of the spindle 3 relative to the component holder 2. On the latter, the component 1 is disposed in any manner relative to the axes perpendicular to the longitudinal axis of the gripping spindle and according to any angle around the same longitudinal axis, but with an accuracy sufficient so that, when the gripping extremity 344 is moved closer to the outer surface of the component 1, this surface obturates completely the suction opening of the gripping extremity so that the component can be sucked in by said gripping extremity 344 when a partial vacuum is introduced by the blank feed attachment 35, spreading as described to the gripping extremity 344.

Once it has been gripped as described, the component 1 is held by partial vacuum on the gripping extremity 344 of spindle 3, its position along the two axes perpendicular to the longitudinal axis of the spindle as well as the angle around this axis being not exactly determined.

The device for aligning exactly the component 1 on the spindle 3 is described in figures 2A and 2B as well as 3A and 3B.

Figure 2A shows an aligning device 4 in open position, that is, ready to receive a component to be aligned. The component is not represented in the figures 2A and 2B in order not to overload them. The device consists of a frame 40 comprising a boring 400 containing two branches of a clamp 41, each of the branches comprising an aligning jaw 410. The central part of clamp 41 is hollow so as to leave space for an opening rod 42 comprising an extremity provided with a stop 420. The internal portion of the branches of clamp 41 comprises a conical section 411 with a plurality of balls 43 trapped between said conical section 411 and the internal section of stop 420. Each branch of the clamp 41 is mounted pivotally on an axis 412. Two springs 401 tend to close the clamp 41. By pushing back the opening rod 42, as can be seen in figure 2B, the balls 43 are freed by stop 420 and can thus move towards the wider portion of the conical section 411, which enables the jaws 410 to move closer. Two stops 413 resting against a sleeve 421 surrounding rod 42 limit the closing movement of the jaws 410, in order to avoid crushing or spoiling the component's pins.

The figures 3A and 3B, which are views along line III-III of figures 2A and 2B, show the shape of the jaws 410 and their aligning effect on component 1. Component 1, held as indicated above by spindle 3, is brought opposite an aligning device 4 whose jaws 410 are open. The spindle 3 is then brought closer to the aligning device, the guiding means 312 of spindle 3 (see figure 1), constituted for example of two rods with protruding conical extremities, are introduced into the guiding holes 402 provided in frame 40 of the aligning device. This movement continues until component 1 comes between the open jaws 410. In view of the floating construction of spindle 3 described above, an exact positioning of spindle 3 relative to the aligning device 4 is possible via the guiding means 312 and 402 described. In figure 3A, it can be seen that component 1 has been introduced between the open jaws 410 and that this component is not correctly aligned relative to the two protruding guiding rods 312, the misalignment being in planes X, Y and around an axis perpendicular to said plane. Figure 3A shows that by moving closer the two jaws 410, component 1 will align correctly due to the particular shape of the jaws which are able to guide the contact pins of the component until the latter is entirely enclosed between the two jaws 410, which corresponds to a perfect alignment of component 1, respectively of its contact pins, in relation to the two guiding rods 312. It can be seen that, for the

alignment, the jaws 410 act by pushing the pins of component 1 and not the housing. One skilled in the art will thus understand that the moving closer of the jaws 410 must be effected gently so as not to risk breaking or twisting a contact pin. In figure 3B, it can be seen that moving closer the jaws 410 has made it possible to align component 1 relative to the plane and to the axis mentioned above. The position of component 1 and notably of its pins is thus exactly known relative to the protruding rods 312 of spindle 3. During this aligning operation, component 1 is fixed to the gripping extremity 344 of spindle 3 by suction.

Alternatively, if the effort required from the jaws 410 on the pins in order to align component 1 is too important and risks breaking or twisting said pins, it is also possible to provide a supporting side 403 (see figure 2A) between the jaws 410 for receiving the component to be aligned. The elastic mounting of spindle 3 prevents component 1 from being crushed on supporting side 403 when spindle 3 and device 4 are moved closer. When the jaws 410 move closer in order to align the component, the suction in the spindle can thus be interrupted since the component is held by supporting side 403, which decreases the component's resistance to the alignment.

Now that the position of component 1 is known exactly relative to rods 312, the suction is re-established if necessary, the jaws 410 are moved apart and the spindle 3 is moved away from aligning device 4 until the protruding rods 312 are entirely disengaged from the guiding holes 402. Component 1 is then conveyed towards the testing station as seen in figure 4.

Testing station 5 comprises notably a plurality of contact tracks 50, each corresponding to a contact pin of component 1, each of said tracks being individually connected electrically to an electronic testing unit, not represented in the figure, said testing unit being able to verify the electronic functioning of component 1. Testing station 5 further includes two guiding means 51, able to meet the guiding means of spindle 3, in particular the guiding rods 312. The relative position of contact tracks 50 and of the guiding means 51 is known exactly. When a spindle 3 is brought close to testing station 5, as represented in figure 4, the two guiding rods 312 are first engaged in guiding means 51 so as to correctly align spindle 3 relative to testing station 5. A perfect alignment of spindle 3 relative to testing station 5

is possible thanks to the floating construction of spindle 3 previously described. Spindle 3 is brought closer to testing station 5 until the contact pins of component 1 make contact with contact tracks 50 of the testing station. In view of the elastic mounting of spindle 3, there is no risk of crushing or spoiling of the contact pins of component 1.

Since on the one hand the contact pins of component 1 were aligned exactly relative to guiding rods 312 on spindle 3 and since on the other hand, by construction, the contact tracks 50 are aligned exactly relative to guiding means 51, the co-ordination of guiding rods 312 and guiding means 51 securely leads each contact pin onto the corresponding contact track.

The electronic test of component 1 can now be conducted, the component remaining fixed to spindle 3 by suction. Then spindle 3 is moved away from test station 5 and, if the test is successful, can be directed towards a component conditioning or storing station or, taking advantage of the fact that component 1 remains aligned on spindle 3, can be directed towards a station where the component is fitted on a socket or the pins are welded on the tracks of a printed circuit. One skilled in the art will understand that such a fitting station essentially has the same elements as those described for the testing station of figure 4, the infeed and alignment of component 1, respectively of the pins of said component relative to the socket or to the tracks of the printed circuit, being carried out exactly as described, the testing operation being replaced by the adequate fitting operation. In the case where the test on the testing station is not successful, the spindle is conveyed towards a reclaiming station of failed components.

The gripping spindle 3 as well as the aligning device 4 and the testing station 5 or the fitting station have been described as being separate and independent devices. In fact, these elements belong to one and the same device which can be configured differently according to the applications and needs. Similarly, the simultaneous use of a single element has been described whereas several of said elements can function simultaneously.

According to an example of application, the component holder 2 of figure 1 can be disposed on a production line or carrousel. At a determined

place of this production line, generally when the manufacture or assembly of component 1 is completed, one or several gripping spindles 3 can be operated simultaneously to each grip a component as described previously, said spindle or spindles being then simultaneously presented each in front of an aligning device 4 as described previously, then, once the components are aligned, the spindles are simultaneously presented each to a testing station 5 or a fitting station. According to another alternative embodiment, the component holders 2, the aligning device 4 as well as the testing station 5 and/or fitting station can be disposed on a production line or carrousel, and the gripping spindle 3 can be disposed at the end of a robotized arm able to displace said spindle opposite each of the mentioned elements. Other configurations of a gripping and aligning device for testing and/or fitting a component can be considered, one skilled in the art being able to adapt the teachings given here to his problem.

Although the above description and figures pertain more particularly to the case of the alignment of electronic components encapsulated in a housing of the type "dual in line", one skilled in the art will understand that the device according to the invention can easily be adapted for aligning components of practically any type, comprising contact pins on one, two or four lateral sides of the housing, or an array of pins on the lower side of the housing, of the type CGA or BGA for example, for testing or any other operation requiring an alignment of the component, respectively of its pins. In particular, the shape of the jaws 41 which serve to align the component will have to be adapted according to the type, shape and dimensions of the component to be aligned.

Diverse technical construction characteristics have been described or represented regarding the gripping spindle 3 and the aligning device 4. It is obvious that these characteristics can be adapted, for example the means provided to give elasticity and make the spindle 3 floating can be different from what has been described above, or the aligning means provided on the device 4 can include only one branch of a mobile clamp or an operation of this clamp different from what has been described.

Claims

1. Device for gripping and aligning , on a gripping spindle (3), an electronic component comprising a housing provided with contact pins, wherein said device comprises an alignment device (4) able to act on the pins of said electronic component in order to align the latter relative to guiding means (312) of said gripping spindle (3), wherein said aligning device (4) comprises a clamp (41) comprising two mobile branches, each being pivotally mounted around a rotational axis (412), each branch bearing a jaw (410), the jaws being able to move closer or apart by operating means (42, 43), each jaw (410) having a shape suitable for aligning the contact pins of a component (1) disposed between said jaws when the jaws are moved closer together

characterized in that

said shape comprises a first rectilinear alignment surface, essentially perpendicular to the moving direction of said jaws, the length of said first alignment surface being at least equal to the overall distance between the pins situated on the two extremities of a line of contact pins, as well as two secondary alignment surfaces disposed perpendicularly to a supporting plane of the electronic component on the gripping spindle and obliquely relative to said first alignment surface, each being disposed at one extremity of said first alignment surface, so as to partially surround said component.

2. Device according to claim 1, characterized in that the operating means comprise a rod (42) fitted with a stop (420) on one of its extremities, a plurality of balls (43) being disposed between a portion of said stop and an oblique portion (411) of said branches of the clamp (41), the longitudinal displacement of the rod in one or the other direction controlling the moving apart or closer of the jaws (410) of the clamp (41).

3. Device according to one of the preceding claims, characterized in that the aligning device further comprises a supporting side (403) able to receive a side of the component to be aligned.

4. Device according to one of the preceding claims, characterized in that said guiding means of said gripping spindle (3) comprise at least two protruding rods

(412) parallel to each other, each of said rods being able to enter into a corresponding guiding opening (402) of the aligning device (4).

5. Device according to claim 4, characterized in that each of the protruding rods (412) is also able to enter into a guiding opening (51) of a component testing station (5) or a component fitting station.

6. Device according to one of the preceding claims, characterized in that the component (1) is held on the gripping spindle (3) by suction.

7. Device according to one of the preceding claims, characterized in that the component (1) is held by suction on a gripping extremity (344) of the gripping spindle (3), said gripping extremity being mounted floatingly relative to a spindle support (30).

8. Use of a device according to one of the preceding claims for testing electronic components on a testing station.

9. Use of a device according to one of the claims 1 to 7 for fitting an electronic component on a socket or a portion of a printed circuit.