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Description

Method and apparatus for gauging a device for producing electrical assemblies

The invention relates to a method for gauging a device for producing electrical assemblies, particularly for fitting components to printed circuit boards on the basis of coordinates, the device being used to fit plate-like emulations of the components to a test board of the printed circuit board type at defined mounting points.

Previously, it was customary for the test board used to be a glass plate, similar to a printed circuit board, having centering marks in its corner regions. The glass plate, provided with a double-sided adhesive film, is placed into the device designed as a fitting machine, for example, and then the position of the centering marks is determined using a spatially resolving printed circuit board camera on the fitting machine. Emulations of components are then fitted to the test board at points defined relative to the centering marks.

In a subsequent method step, the populated glass plate is placed into an optical measuring machine. The glass laminae have defined markers whose position is determined relative to the centering marks on the glass plate in the measuring machine. Any divergences in position from the desired ideal position are used to determine correction values in the coordinate directions and for the rotary position, said correction values being input as correction parameters into the fitting machine, which takes these divergences into account when subsequently fitting components to printed circuit boards.

The invention is based on the object of making it easier to determine the correction parameters, and of speeding up this determination.

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This object is achieved by the invention as claimed in claims 1 to 6.

A prerequisite for this is that the local reference marks are placed on the test board with a high level of accuracy. Such accuracy can be achieved, for example, using photolithographic methods. For the emulations, it is possible to dispense with a marker and to use the external edges, for example, of the emulations as defined structural features instead of the marker. In such cases, it is advantageous to replace the glass laminae with appropriate ceramic or metal parts in which the edges are easily discernible.

The essential advantage of the method is that the global position of the emulations with respect to the global reference marks on the test board is now no longer gauged, but instead only narrow sections are taken into consideration and gauged. Such measuring procedures do not require a high-precision measuring machine. The short distances between the structural features and the local markers make it possible, for small measuring errors, to determine the divergences in the position of the emulations using simple optical instruments, for example.

Advantageous developments of the invention are identified in the following claims:

The features of claim 2 enable the relative position of the reference marks with respect to the structural features of the emulations to be determined in one go without having to move the sensor. Hence, measuring inaccuracies now depend only on the quality of the sensor optics. All other machine influences are thus completely eliminated. The sensor, which is designed as a CCD camera, for example, is connected to evaluation electronics which calculate the relative position of the structural features with respect to the reference marks.

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The development as claimed in claim 3 enables the test board, in a relaxed state, to be both fitted with the emulations and to be gauged without any additional handling, e.g. using the printed circuit board camera. This eliminates the errors occurring when the measuring plate is centered. The test board can be fitted with components and the printed circuit board camera can be moved by means of one and the same controller.

After the position has been determined for all the mounted emulations, the systematic divergences are calculated in an evaluation device. This evaluation device can be a program module, for example, which is incorporated in the controller for the device and transmits the calculated correction parameters, as claimed in claim 4, for example, as constants without further action by the machine control.

A particular advantage of such a method is that such calibration procedures can be carried out, not only with newly manufactured machines but also with machines which are already in use, from time to time without any particular difficulty and without other auxiliary means, for example during maintenance measures carried out on a rota basis. This means that wear- or age-related changes in the positioning procedures, for example, can easily be checked and corrected.

The high speed when gauging the markers makes it possible to use a large number of emulations, as in claim 5, so that an adequate number of measurements can be carried out for statistical evaluation.

The development as claimed in claim 7 makes it possible to determine the angular position of the emulations by gauging, as in claim 8, for example, the diagonally opposite corner regions, which are at a sizable distance from one another.

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As a result of the development as claimed in claim 9, the structural features are given the same optical properties as the reference marks. This means that the sampling optics can be optimally adjusted, because, when the markers are evaluated, the same distinguishing criteria apply as for the reference marks, which simplifies evaluation.

The emulations as claimed in claim 10 have good stability of shape, even at different temperatures. The arrangement of the markers means that they are at the same level as the reference marks, which prevents parallax errors.

The development as claimed in claim 11 makes it possible also to use opaque ceramic material for the emulations instead of transparent material, the markers then being arranged on the top.

The invention is explained in more detail below with the aid of an exemplary embodiment illustrated in the drawing, in which:

Figure 1 shows a plan view of a test board with emulations of components mounted on it,

Figure 2 shows an enlarged detail from the test board shown in Figure 1.

As shown in Figures 1 and 2, a test board 1 made of a glass plate has global centering marks 2 in two diagonally opposite corners. In a fitting machine for electrical components, emulations 3 of such components are fitted to the test board 1 at defined points, the centering marks 2 serving to center the position of the emulations 3 in the fitting machine.

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The emulations 3 comprise small glass laminae which each have markers 4 similar to crosshairs in two diagonally opposite corners. At these points, the test board 1 is provided with local reference marks 5 applied with high positional precision at a short distance from the markers 4.

The markers 4 and the reference marks 5 are so close to one another that they fit in a scanning field 6 of a spatially resolving optical sensor attached to a fitting head for the components. This fitting head can be moved such that the sensor can be positioned over all the marked corner regions.

The spatially resolving sensor is connected to evaluation electronics which can determine the relative position of the markers 4 with respect to the respective reference mark 5 without the sensor having to be moved to do so. A controller (not shown) for the fitting device has an evaluation module which processes the individual divergences of the markers 4 from the reference marks 5 to produce correction parameters for the machine. These correction parameters are automatically adopted by the controller.

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Patent claims

1. A method for gauging a device for producing electrical assemblies, particularly for fitting components to printed circuit boards on the basis of coordinates, the device being used to fit plate-like emulations (3) of the components to a test board (1) of the printed circuit board type at defined mounting points, the position of the emulations (3) relative to reference marks (5) on the test board (1) being determined by an optical sensor using positionally defined optical structural features (e.g. 4) of the emulations (3), and divergences of the position of the structural features (e.g. 4) from their ideal position being used to calculate at least one correction parameter for a controller for the device for producing the assemblies, characterized in that the reference marks (5) are fitted locally to the mounting points of the emulations (3), and in that the position of the structural features (e.g. 4) is determined relative to the local reference marks (5) assigned to each of them.

2. The method as claimed in claim 1, characterized in that the distance between the reference marks (5) and the optical structural features (e.g. 4) of the mounted emulations (3) is shorter than the width of a scanning field (6) of the spatially resolving sensor, in that the sensor is moved gradually over the reference marks (5) and the structural features (e.g. 4), in that the sensor takes pictures of these points, each of these pictures containing both the reference mark (5) and the structural feature (e.g. 4), and in that the relative position of the respective structural feature (e.g. 4) and the reference mark (5) with respect to one another is determined by evaluating the pictures taken.

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3. The method as claimed in claim 1 or 2, characterized in that the sensor is part of the device for producing the printed circuit boards, and in that the pictures are evaluated and the correction parameter is calculated using an optical evaluation device associated with the device for producing the assemblies.

4. The method as claimed in claim 3, characterized in that the correction parameter determined by the evaluation device is automatically transmitted to the controller and is stored by the latter.

5. The method as claimed in claim 4, characterized in that the test board (1) has a multiplicity of emulations (3) fitted to it throughout at a short distance apart, and in that the position of all the emulations (3) is determined.

6. An apparatus for performing a method for gauging a device for producing electrical assemblies, particularly as claimed in one of the preceding claims, the device being used to fit emulations (3) of the components to a test board (1) of the printed circuit board type at defined mounting points, the position of the emulations (3) relative to reference marks (5) on the test board (1) being determined by an optical sensor using positionally defined optical structural features (e.g. 4) of the emulations (3), and determined divergences of the position of the structural features (e.g. 4) from their ideal position being used to calculate at least one correction parameter for a controller for the device for producing the assemblies, characterized in that

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the local reference marks (5) are fitted at the mounting points of the emulations (3) in the immediate vicinity of the optical structural features (e.g. 4) of the mounted emulations (3), and in that the distance between the reference marks (5) and the optical structural features (e.g. 4) of the mounted emulations (3) is shorter than the width of a scanning field (6) of the spatially resolving sensor.

7. The apparatus as claimed in claim 6, characterized in that, at each of the mounting points, an additional reference mark (5) is fitted and assigned to additional structural features (e.g. 4) of the emulations (3), and in that these additional reference marks (5) and structural features (e.g. 4) can be detected by the sensor.

8. The apparatus as claimed in claim 6 or 7, characterized in that the reference marks (5) are arranged at the corners of the emulations (3) designed as square plates.

9. The apparatus as claimed in claim 6, 7 or 8, characterized in that the optical structural features (e.g. 4) of the emulations (3) are designed as markers (4) similar to the reference marks (5).

10. The apparatus as claimed in claim 8, characterized in that the emulations (3) are made of inorganic transparent material, particularly glass, and in that the markers (4) are fitted on that side of the emulations (3) which faces the test board (1).

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11. The apparatus as claimed in one of claims 6 to 10, characterized in that the reference marks (5) are arranged on the test board (1) outside the mounted emulations (3).

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