

To that end, the devices for picking up and setting down the components must be measured and then adjusted in order to compensate for manufacturing and mounting tolerances. This is carried out by an operator, who first visualizes the pick-up and set-down device with the aid of a microscope or a camera image and then measures and adjusts it. The method is extremely time-intensive, susceptible to errors in practice and ties up highly qualified personnel. The greater the complexity of a device, in particular the greater the number of individual device components that have to be adjusted relative to one another, the greater the outlay in terms of time and the susceptibility to error/inaccuracy of the adjustment.

Problem to be solved

A component-handling device is to allow a precise adjustment to be carried out in a time-efficient manner.

Solution presented herein

This object is achieved by a component-handling device for removing prismatic components from a structured component supply and depositing the removed components at a reception device which has an integrated self-adjustment device. A first turning device having a plurality of pick-up elements is adapted to receive a component from the structured component supply at a dispensing point to turn the received component through a first predetermined angle about its longitudinal or transverse axis deposit point to feed. Position and property sensors associated with the first and second turning devices are adapted to detect position data of the first and second turning devices, position data of components situated at the pick-up elements, and/or properties of components situated at the pick-up elements, and to provide them to a controller.

The controller is adapted to determine, by means of position and property sensors, in particular before the actual component transfer operation, in the course of a self-adjustment, for each transfer position in which the first and/or the second turning device receive or transfer components, a correction vector for the first and/or the second turning devices and/or for the deposit point, which correction vector in each case counteracts the manufacturing and mounting inaccuracies of the component-handling device determined in the course of the self-adjustment.

second and/or third axes by approximately plus/minus not more than 20%, preferably by up to plus/minus 3%, of the spacing of adjacent component receivers of the carrier.

5 In a variant of the reception device, the fourth rotary drive is adapted to feed the carrier guided by the reception device forwards along one of the first and/or second axes according to a spacing of adjacent component receivers of the carrier.

10 In a variant of the reception device, a suction and/or blow-off device is provided for removing a component identified as being damaged and/or incorrectly placed from at least one of the reception points in the reception device and/or the carrier guided in the reception device.

15 During operation of a variant of the reception device, a sprocket wheel driven by the fourth rotary drive engages in transport holes in the deposit tape for transport thereof in the feed direction. The sprocket wheel preferably rotates only in a forward direction. The deposit tape has deposit pockets for the components at regular intervals. The sprocket wheel rotates by a fixed angle (e.g. 30°, 60°, 90°, 180°..., 360°) for each deposit pocket. The position of the deposit pocket in which the
20 component was deposited is known from the image recorded by the camera in the center of the second turning device. Moreover, it is known from the camera at the outer periphery of the second turning device whether the next component to be deposited is out of position at the pick-up element. From this position information, the distance and/or angle by which the reception device must be repositioned is
25 calculated in the controller. In addition, the positioning of the reception device also takes account of the fact that the turning device will correspondingly move in the x- and y-direction in order correctly to transfer the component from the upper turning device to the lower turning device at the transfer position. The reception device is then, where necessary, moved linearly along the (X-, Y-) axes and optionally rotated
30 in order to ensure the fine adjustment of the deposition of the component.

35 When a component has been deposited in the deposit position, the camera in the center of the second turning device arranged thereabove has also detected whether the component is faulty, that is to say whether it has been damaged by the deposition or already had a defect beforehand. If a component was identified as being defective beforehand, it is not deposited.

viewing window. In another variant, the camera positioned in the center of the first (upper) turning device has a mirror arrangement which allows the component ejector to be detected indirectly while the turning devices are in a position provided for the transfer of components (transfer position).

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The integrated handling/inspection device disclosed here additionally uses imaging sensors in the form of lateral cameras on the upper turning device. These cameras are arranged at approximately 90° radially outside the upper turning device, in such a manner that the front of the component is detected on its circular path by a middle camera and mutually opposite lateral faces are detected by on both sides of the middle camera. These cameras are not necessarily color cameras. A plurality of image acquisitions can be prepared, because the upper turning device stops in the 180° position for a short time (10 ms to 60 ms, for example 40 ms) because of the subsequent component transfer. This brief stoppage time is sufficient for the inspection. Black and white cameras can also be used for this purpose. With the lateral inspection by the two lateral cameras, the ends of the component are checked for damage. With the rear-side inspection by the middle camera, the rear side of the component is checked for damage. A plurality of image acquisitions can be made for the rear-side inspection in order to highlight different defects. The cameras used here can likewise be color cameras. However, this is not absolutely essential because, as already mentioned above, sufficient time is available due to the stoppage period.

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The integrated handling/inspection device disclosed here additionally uses imaging sensors in the form of lateral cameras on the lower turning device. These cameras are arranged at approximately 90° radially outside the lower turning device, in such a manner that the front of the component is detected on its circular path by a middle camera and mutually opposite lateral faces are detected by the cameras situated on both sides of the middle camera. These cameras are not necessarily color cameras. Instead, black and white cameras can also be used. At this position, the component is both checked for defects, and the image data are evaluated for position data. With the lateral inspection by the two lateral cameras, the component is checked for damage on its cut faces. With the rear-side inspection by the middle camera, the rear side of the component is checked for damage. A plurality of image acquisitions can be made for the rear-side inspection, in order to highlight different defects. For the subsequent deposition of the component in the reception device, the position data (x, y, twist) of the component can be determined with the lateral inspection. In

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orientations when the inspected component B is transferred at the transfer point ÜS from the second turning device 150 into the reception point ES1 situated at the deposit point ABS, that is to say the pocket of the carrier 320. In addition, the third camera arrangement K3 is also suitable for determining the deviation of each pick-up
5 element 152 of the second turning device 150 from a previously defined common reference point.

The fourth camera arrangement K4 is directed, as a position and property sensor in the center of the second turning device 150, at the reception point E1 in the
10 reception device 200. The controller ECU then effects corresponding correction movements of the second turning device 150 and of the reception device 200. The camera arrangement K4 is further adapted to detect both the reception point ES1 and the pick-up element 152 situated at the deposit point ABS from different detection directions at the same time by means of mirror optics, so that a relative
15 position of the reception point ES1 to the pick-up element 152 can be determined by the controller ECU for the self-adjustment of the component-handling device 100.

The component-handling device 100 shown in Fig. 1 comprises a controller which controls the autonomous adjustment of the component-handling device 100.

20 Self-adjustment is possible in particular before the component-handling device 100 is taken into operation but also during operation of the component-handling device 100.

25 Any desired combinations of the camera arrangements K1, K4, K7, K8, K9, K10 and K11 for the self-adjustment of the component-handling device 100 are possible if at least one sensor directed at the dispensing point SPS, at least one sensor directed at the transfer point ÜS and at least one sensor directed at the deposit point ABS are involved in the self-adjustment process.

30 In the variant in which the components are transferred from the first turning device 130 to the reception device 200, two camera arrangements are sufficient for the self-adjustment of the component-handling device 100 if at least one sensor directed at the dispensing point SPS and at least one sensor directed at the deposit point ABS
35 are involved in the self-adjustment process.

The controller is adapted gradually to rotate the first turning device 130 during the self-adjustment process and to determine a position of each individual pick-up element 132 of the first turning device 130 relative to the ejection unit 110 by means of the camera sensors K1 and/or K8. By means of the camera sensors K7 and/or K10 and/or K11, the position of the pick-up element 152 of the second turning device 150 situated at the transfer point ÜS in relation to the pick-up element 132 of the first turning device 130 situated at the transfer point is determined. By means of the camera sensors K9 and/or K4/K7 (K4 in the variant with two turning devices 130, 150 and K7 in the variant with one turning device 130), the position of the reception point ES1 situated in the reception device 200 relative to the pick-up element 132, 152 of the first/second turning device 130, 150 situated at the deposit point ABS is determined.

In the variant with only a first turning device 130, only the relative positions at the dispensing point SPS and the deposit point ABS are determined.

The controller is adapted to repeat the gradual rotation of the turning devices 130, 150 and the determination of the relative position at least until all possible transfer positions of the turning device 130, 150 at the dispensing point SPS, the transfer point ÜS and the deposit point ABS have been reached at least once. The controller is further adapted to store the determined values in a control table.

The determined 3-dimensional position deviations of the pick-up elements 132 of the first turning device 130 relative to a previously defined position in relation to the ejection device 110 form in operation the 3-dimensional correction vector for the first turning device 130 for the particular transfer position.

The determined 3-dimensional position deviations of the pick-up element 152 of the second turning device 150 situated at the transfer point ÜS relative to a previously defined position in relation to the pick-up element 132 of the first turning device 130 form in operation, when added to the 3-dimensional correction vector for the first turning device 130 for the particular transfer position, the 3-dimensional correction vector for the second turning device 150 for the particular transfer position.

The determined 3-dimensional position deviations of the reception points ES1 relative to a defined position in relation to the pick-up element 152 of the second turning device 150 situated at the deposit point ABS form in operation, when added to the 3-