

Claims

1. Component ~~conveyor~~conveying device (100), comprising

- a first conveying instrument (F1) for conveying a component;

- a second conveying instrument (F2) for conveying the component;

wherein the first conveying instrument (F1) is arranged to transfer the component to the second conveying instrument (F2) at a transfer location (ÜS);

- an adjustment unit for adjusting one of the two conveying instruments (F1, F2) relative to the other conveying instrument (F2, F1) along at least one or about at least one adjustment axis (x-, y-, z-axis);

- an imaging unit (K1) which is set up to record at least one image (B1, B2, B3, ... B11) of the transfer location (ÜS), which image (B1, B2, B3, ... B11) shows at least one end region (E1) of the first conveying instrument (F1) in a first section (H1) and at least one end region (E2) of the second conveying instrument (F2) in a second section (H2);

- an analysis unit, coupled to the adjustment unit, for analyzing the at least one image (B1, B2, B3, ... B11), which analysis unit is set up to determine from the at least one image (B1, B2, B3, ... B11) a measure of an asymmetry (A1, A2, A3, ... A11) between the end region (E1) of the first conveying instrument (F1) and the end region (E2) of the second conveying instrument (F2);

- the adjusting unit being set up to adjust at least one of the two conveying instruments (F1, F2) with respect to the other conveying instrument (F2, F1) along the at least one adjusting axis (x, y, z axis) or about the at least one adjusting axis (x, y, z axis) as a function of the determined asymmetry measure (A1, A2, A3, ... A11).

2. Component conveying ~~instrument~~device (100) according to claim 1, wherein the analysis unit is adapted to use a mirror axis (SA), which is either oriented perpendicular to a transfer path (W) of the component or coincides with the transfer path (W), for determining the asymmetry measure (A1, A2, A3, ... A11) between the end region (E1) of the first conveying instrument (F1) and the end region (E2) of the second conveying instrument (F2).

3. Component conveying ~~apparatus~~device (100) according to claim 2, wherein the analysis unit is adapted to determine, for the asymmetry measure (A1, A2, A3, ... A11)

(a) to detect a grey value for each pixel (B₁, B₂, B₃, ...) on one side of the mirror axis (SA),

(b) to determine the mirrored pixel (B₁', B₂', B₃', ...) for the pixel under consideration (B₁, B₂, B₃, ...) with the mirror axis (SA) in each case and to detect its grey value,

(c) determining in each case a difference value (Δ_1 , Δ_2 , Δ_3 , ...) which represents a measure of the difference between the grey value of the pixel (B₁, B₂, B₃, ...) and the grey value of the mirrored pixel (B₁', B₂', B₃', ...), and

(d) to sum up all difference values (Δ_1 , Δ_2 , Δ_3 , ...) determined in this way,

wherein the sum ($\sum \Delta_i$) formed in step (d) determines the asymmetry measure (A1, A2, A3, ... A11) to the image (B1, B2, B3, ... B11) in question.

4. Component conveying ~~instrument device~~ (100) according to claim 42, wherein the analysis unit is adapted to determine, for the image in question, the measure of asymmetry by

- (a) creating a mirror image, which is generated by a reflection around a mirror axis, which is at least approximately parallel to the ~~movement transfer~~ path (W),
- (b) acquiring the grey values for each pixel of the image and the corresponding pixel of the mirror image,
- (c) determining in each case a difference value which represents a measure of the difference between grey value of the image point and the grey value of the corresponding image point of the mirror image,
- (d) summing up all the difference values determined in this way,
- (e) producing at least one further mirror image by moving the mirror image produced in step (a) in a direction perpendicular to the mirror axis, and
- (f) repeating steps (b) to (d) using the at least one further mirror image,

wherein the respective sums produced in step (d) are compared and the minimum of the sums determines the asymmetry measure for the image concerned.

5. Component conveying ~~apparatus device~~ (100) according to any one of the preceding claims, which is arranged to perform the following steps - in the given order:

- (i) acquiring a first image (B1) with the imaging unit (K1);
- (ii) determining the asymmetry measure (A1) of the first image (B1) by the analysis unit;
- (iii) adjusting one of the two conveying instruments (F1, F2) relative to the other conveying instrument (F2, F1) in a first direction by the adjusting unit;
- (iv) acquiring a second image (B2) with the imaging unit (K1);
- (v) determining the asymmetry measure (A2) of the second image (B2) by the analysis unit;
- (vi) comparing the asymmetry measure (A2) of the second image (B2) with the asymmetry measure (A1) of the first image (B1) by the analysis unit;
- (vii) if the asymmetry measure (A2) of the second image (B2) is smaller than the asymmetry measure (A1) of the first image (B1): further moving the one conveying instrument (F1, F2) with respect to the respective other conveying instrument (F2, F1) in the first direction by the adjusting unit; and if the asymmetry measure (A2) of the second image (B2) is greater than or equal to the asymmetry measure (A1) of the first image (B1): moving one conveying instrument (F1, F2) with respect to the respective other conveying instrument (F2, F1) in a second direction opposite to the first direction by the adjusting unit.

6. Component conveying instrument-device according to claim 5, which is arranged for subsequently carrying out the following further steps in the given order:

(viii) acquiring a third image (B3) with the imaging unit (K1);

(ix) determining the asymmetry measure (A3) of the third image (B3) by the analysis unit;

(x) comparing the asymmetry measure (A3) of the third image (B3) with the asymmetry measure (A2) of the second image (B2) by the analysis unit;

(xi) if the asymmetry measure (A3) of the third image (B3) is smaller than the asymmetry measure (A2) of the second image (B2): further moving the one conveying instrument (F1, F2) with respect to the respective other conveying instrument (F2, F1) in the direction of the last moving by the adjusting unit; and if

the asymmetry measure (A3) of the third image (B3) is greater than or equal to the asymmetry measure (A2) of the second image (B2): moving one conveying instrument (F1, F2) with respect to the other conveying instrument (F2, F1) concerned in the opposite direction to the direction of the last movement by the adjusting unit.

7. Component conveying instrument-device (100) according to any one of the preceding claims, wherein the first conveying instrument (F1) and/or the second conveying instrument (F2) is formed by a pipette or an ejector or a pick-up having a suction contact point.

8. Component conveying instrument-device (100) according to ~~one of the preceding claims~~claim 2, in which the first conveying instrument (F1) and/or the second conveying instrument (F2) is part of a conveying ~~apparatus-instrument~~ (101, 102) which is mounted so as to be linearly movable along an axis and/or rotatable about an axis of rotation, 102) which is mounted so as to be linearly movable along an axis and/or rotatable about an axis of rotation, wherein by means of a presetting movement of the conveying apparatus (101, 102) along the axis or about the axis of rotation the respective conveying instrument (F1, F2) can be moved into a transfer position provided for the transfer of the component (B) along the transfer path (W);

wherein the adjusting unit is adapted to move the respective conveying instrument (101, 102) along the axis and/or to rotate about the axis of rotation for adjusting the transfer position of the respective conveying instrument (F1, F2).

9. Component conveying instrument-device according to claim ~~7~~8, wherein the conveying instrument (101, 102) is a turning device (101) or could be moved in a linear axis (102).

10. Component conveying instrument-device (100) according to any one of the preceding claims, wherein the adjustment axis makes an angle with the ~~main~~-axis (H₀) of the first conveying instrument (F1)

which is between 70° and 110°.

11. Component conveying ~~device~~apparatus (100) according to any one of the preceding claims, wherein a direction (R1) from the imaging unit (K1) to the transfer location (ÜS) includes an angle with the ~~major~~ axis (H₀) of the first conveying instrument (F1) that is between 70° and 110°.

12. Component conveying ~~device~~instrument (100) according to any one of the preceding claims, further comprising a further imaging unit (K2) adapted to capture at least one further image of the transfer location (ÜS), which in a first portion of the at least one further image shows at least one end region (E1) of the first conveying instrument (F1) and in a second portion of the at least one further image shows at least one end region (E2) of the second conveying instrument (F2), wherein a direction (R2) from the further imaging unit (K2) to the transfer location (ÜS) differs from a direction (R1) from the first-mentioned imaging unit (K1) to the transfer location (ÜS).

13. Component conveying ~~device~~instrument (100) according to claim 12, wherein the analysis unit is further adapted to analyze the at least one further image and determine a further asymmetry measure between the end region (E1) of the first conveying instrument (F1) and the end region (E2) of the second conveying instrument (F2); wherein the adjusting unit is arranged to adjust at least one of the two conveying instruments (F1, F2) relative to the respective other conveying instrument (F2, F1) along or about a further adjustment axis (x-, y-, z-axis) in dependence on the determined further measure of asymmetry.

14. Method of setting a component conveying ~~instrument~~device (100) having a first conveying instrument (F1) for conveying a component and a second conveying instrument (F2) for conveying the component, wherein the first conveying instrument (F1) is set up to transfer the component to the second conveying instrument (F2) at a transfer location (ÜS), comprising the steps:

- (ii) acquiring a first image (B1) of the transfer location (ÜS) with an imaging unit (K1);
- (iii) determining an asymmetry measure (A1) of the first image (B1) by an ~~an~~ analysis unit ~~analysis~~;
- (iv) adjusting one of the two conveying instruments (F1, F2) relative to the other conveying instrument (F2, F1) in a first direction (y-direction) by means of a setting unit;
- (v) acquiring a second image (B2) of the transfer location (ÜS) with the imaging unit (K1);
- (vi) determining an asymmetry measure (A2) of the second image (B2) by the unit analysis;
- (vii) comparing the asymmetry measure (A2) of the second image (B2) with the asymmetry measure (A1) of the first image (B1) by the analysis unit;
- (viii) if the asymmetry measure (A2) of the second image (B2) is smaller than the asymmetry measure (A1) of the first image (B1): further adjusting the one conveying instrument (F1, F2) with

respect to the respective other conveying instrument (F2, F1) in the first direction (y-direction) by the adjusting unit; and

(ix) if the asymmetry measure (A2) of the second image (B2) is greater than or equal to the asymmetry measure (A1) of the first image (B1):

5 (x) adjusting one conveying instrument (F1, F2) relative to the other conveying instrument (F2, F1) in a second direction (-y-direction) opposite to the first direction (y-direction) by the adjusting unit.