

Description

The invention relates to a device comprising at least two manipulators, which have parallel centre lines and which can rotate simultaneously about the centre lines by means of a coupling member, each manipulator being provided with an arm which is pivotably connected to the coupling member, while the arms of the manipulators extending parallel to each other have the same length.

The invention further relates to a positioning device suitable for placing electrical components on a support comprising at least two pick-up devices, which have parallel centre lines and can be rotated simultaneously about the centre lines by means of a coupling rod, each pick-up device being provided with an arm which is pivotably connected to the coupling rod, while the Parallel extending arms of the pick-up devices have the same length.

The invention moreover relates to a pick-up device suitable for use in such a positioning device.

A device and a positioning device of the kind mentioned in the opening paragraph are known from US-PS 4,664,591.

In the known devices, the manipulators are driven in common by means of a coupling member. Each manipulator is provided to this end with an arm comprising a radius of a rotatable flange and with a pin connected to the flange. The coupling member is pivotably connected to the pin of each manipulator. The length of the arm is equal to the distance of the pin from the centre line of the manipulator and is equally large for all manipulators. Connection lines perpendicular to the centre lines of the manipulators between the centre lines and the pins associated with the manipulators extend parallel for all manipulators. Via the coupling member, all manipulators are driven simultaneously so that identical rotary movements are performed.

A disadvantage of the known device is that the pitch distance between two adjacent manipulators is determined by the dimensions of the flanges and the length of the arms.

The invention has *inter alia* for its object to provide a device, in which a high degree of freedom is obtained in the choice of the distance between two adjacent manipulators.

A device according to the invention is for this purpose characterized in that each arm encloses an obtuse angle with the centre line of the associated manipulator and encloses with a plane of projection perpendicular to the centre line of the manipulator an acute angle forming part of the obtuse angle, while during operation corresponding points of the arms of two adjacent manipulators describe paths which, viewed in projection, intersect each other in the said plane of projection.

The device according to the invention permits of

reducing the distance between two adjacent manipulators to a pitch distance which is determined only by other dimensions of the manipulators. The length of the arm of a manipulator no longer influences the pitch distance.

With a given distance between two pick-up devices, in the device according to US-PS 4,664,591 the length of the arm is determined by the distance between two pick-up devices. The invention further has for its object to provide a positioning device for placing electrical components on a support, in which the length of an arm no longer depends to such a great extent as before upon the distance between two adjacent pick-up devices.

The positioning device according to the invention is for this purpose characterized in that each arm encloses an obtuse angle with the centre line of the associated pick-up device and encloses with a plane of projection perpendicular to the centre line of the pick-up device an acute angle forming part of the obtuse angle, while during operation corresponding points of the arms of two adjacent manipulators describe paths which, viewed in projection, intersect each other in the said plane of projection.

The positioning device according to the invention has great advantages because the accuracy with which a component picked up by a pick-up device is subjected to a given angular rotation should be as high as possible. The length of the arm is also determinative of the accuracy with which a given angular rotation can be obtained; the greater the length of the arm, the higher is the accuracy. The pick-up devices can be arranged at a comparatively small pitch distance, while the length of the arms can be chosen so that a desired accuracy is attained.

The invention further relates to a pick-up device suitable for use in such a device. The pick-up devices can be used individually or together with other pick-up devices, while by a comparatively great length of the arm a high accuracy can be obtained when performing an angular rotation.

The invention will be described more fully with reference to the drawing, in which:

- Figure 1 shows diagrammatically a device according to the invention, which is suitable for placing electrical components on a support,
- Figure 2 is a plan view of the device shown in Figure 1,
- Figure 3 shows diagrammatically a pick-up device according to the invention.

A device 1 shown in figure 1 has a row of pick-up devices 3. Each cylindrical pick-up device 3 is rotatable about a centre line 9 and is journaled coaxially in a holder 7, which is connected to a frame 5. Each pick-up device 3 is provided with a coaxially arranged duct 11, in which a subatmospheric pressure can be produced so that the pick-up device 3 can suck up a component (not shown). Each pick-up device 3 has

secured to it a crank 13 (arm), which is connected through a pin 15 pivotably to a coupling rod 17 (coupling member). The parallel extending cranks have the same length. If the coupling rods 17 are driven in a manner to be described more fully hereinafter, the cranks 13 and hence also the pick-up devices 11 will perform a rotary movement about the centre lines 9. A point of a crank 13 corresponding to the pin 15 then describes a path which partly coincides with a path described by a corresponding point of a crank 13 of an adjacent pick-up device (see also Figure 2). The coupling rod 17 forms part of a parallel mechanism 19, as a result of which the coupling rod 17 always remains in a position which is parallel to a preceding position. The parallel mechanism 19 comprises the coupling rod 17, two auxiliary rods 21, an auxiliary coupling rod 27 and two base rods 29. The two auxiliary rods 21 are each connected at one end to the coupling rod 17 so as to be pivotable about an axis 23 and are connected at another end to the auxiliary coupling rod 27 so as to be pivotable about an axis 25. The two base rods 29 are each connected at one end to the auxiliary coupling rod 27 so as to be pivotable about the axis 25 and are connected at another end to the frame 5 so as to be pivotable about an axis 31. The coupling rod 17 and the auxiliary coupling rod 27 are arranged parallel to each other. This also holds for the base rods 29 as well as for the auxiliary rods 21. The distance between the axes 23 of the coupling rod 17 is equal to the distance between the axes 25 of the auxiliary coupling rod 27; the distance between the axes 25 and 31 is the same for both base rods 29 and the distance between the axes 23 and 25 is the same for both auxiliary rods 21.

The auxiliary coupling rod 27 serves to pass during operation through a dead position of the coupling rod 17 and to neutralize tolerances in the dimensions of the cranks. The dead position is a position of the coupling rod 17, in which the crank 13 and the coupling rod 17 are directed parallel to each other.

Figure 2 is a plan view of the device 1 according to the invention. With reference to this Figure, the operation of the parallel mechanism 19, the drive of the coupling rod 17 and the paths described by the crank 13 are explained more fully.

The coupling rod 17 is driven by a toothed wheel 33, which is coupled via a gear wheel transmission 35 to a motor 36. The centre line 37 of the toothed wheel 33 is located in the same plane 39 as the centre lines 9 of the pick-up devices 3. The toothed wheel 33 is coupled via a pin 41 to the coupling rod 17, a distance L_1 between the centre line 37 of the toothed wheel 33 and the pin 41 being equal to a distance L_2 between the centre line 9 of a pick-up device 3 and the associated pin 15. A line perpendicular to the centre line 37 from the toothed wheel 33 to the pin 41 and a line perpendicular to the centre line 9 from a pick-up device 3 to a pin 15 extend parallel to each other. Due

to the rotation of the toothed wheel 33 by means of the motor 36, a circular path 43 is described by the pin 41. By means of the pin 41, the coupling rod 17 describes a circular path so that the cranks 13 of all pick-up devices 3 also describe equal circular paths 43. Paths 43 of adjacent pick-up devices 3 intersect each other in the points A and B (see Figure 2).

The pick-up devices 3 are arranged at a comparatively short relative distance, as a result of which a compact construction of the device is obtained.

An embodiment of a pick-up device according to the invention is shown in Figure 3. The cylindrical pick-up device 3 is rotatable about a centre line 9 and is journaled coaxially in a circular holder 7, while it is provided with a coaxially arranged duct 11. A subatmospheric pressure is produced through connections 45 of the holder 7 in the duct 11 of the pick-up device 3. The crank 13 encloses an obtuse angle β with the centre line of the pick-up device 3 and an acute angle α with a plane of projection 47, which is perpendicular to the centre line 9 of the pick-up device 3. (The projection plane 47 is perpendicular to the plane of Figure 3.) The angle α forms part of the angle β , while it holds that $\beta = \alpha + 90^\circ$.

By means of the pick-up device 3, components can be picked up in that a subatmospheric pressure is produced in the duct of the pick-up device 3. The pick-up device 3 is slipped partly out of the holder 7 in a direction indicated by the arrow 49 during the pick-up operation. After the pick-up device 3 has picked up a component, the pick-up device 3 is slipped for the major part back into the holder 7. When the component is placed on a support for components, the pick-up device 3 is first slipped out of the holder 7; the subatmospheric pressure is eliminated, as a result of which the component is placed on the support.

Each pick-up device can be driven individually to pick up or to place a component. It is then necessary that the pick-up device is slipped out of the holder when picking up or placing components. Thus, for example, during placement, an adjacent pick-up device is prevented from colliding with components already placed on the support.

For picking up components, the device 1 should be moved to a pick-up position. For placing components, the device 1 is moved to a placement position above a support for components. This may be effected, for example, by means of a device described in US-PS 4,644,642.

By means of a device according to the invention, the components picked up by the pick-up devices can be rotated and directed very carefully, while the pick-up devices are arranged at a comparatively small relative distance. If a higher accuracy is required, this can be simply obtained in that the length of the cranks 13 is increased. As a matter of course, the toothed wheel must then also engage with the coupling rod at

a greater distance ($L_1 = L_2$).

In the embodiment described above of a device according to the invention, the manipulators are constituted by pick-up devices. However, the manipulators may also comprise tools, sensors, carriers of pins etc., by which accurate angular rotations must be performed. For this purpose, known manipulators may be used, which, after having been provided with a suitable arm, are suitable for use in a device according to the invention.

The centre lines of the manipulators need not absolutely be located in the same plane, as in the embodiment shown. For example, the parallel centre lines may be arranged in a triangle. Instead of by a coupling rod, the coupling member may then be constituted by a coupling plate, which is pivotably connected to the arms of the manipulators.

The pick-up device in the embodiment shown picks up components by means of subatmospheric pressure produced in the duct. The pick-up device could also pick up components by means of grippers.

The movement of the pick-up device in the holder in the direction of the arrow 49 may be omitted when the pick-up devices simultaneously pick up or place components and there is no risk of collision.

The auxiliary coupling rod in the embodiment of a device according to the invention assists the coupling rod in passing through a dead position of the coupling rod. However, this may also be realized by known means. If the rotation of the manipulators is limited to a part of a complete rotation and a dead position of the coupling rod is not reached, mechanisms for passing through the dead position may be omitted. Thus, the device is simplified.

Claims

1. A device comprising at least two manipulators, which have parallel centre lines and can rotate simultaneously by means of a coupling member about the centre lines, each manipulator being provided with an arm pivotably connected to the coupling member, while the parallel extending arms of the manipulators have the same length, characterized in that each arm encloses an obtuse angle with the centre line of the associated manipulator and encloses with a plane of projection perpendicular to the centre line of the manipulator an acute angle, which forms part of the obtuse angle, while during operation corresponding points of the arms of two adjacent manipulators describe paths, which, viewed in projection, intersect each other in the said plane of projection.
2. A positioning device suitable for placing electrical components on a support, comprising at least two pick-up devices which have parallel centre

lines and can be rotated simultaneously by means of a coupling member about the centre lines, each pick-up device being provided with an arm pivotably connected to the coupling member, while the parallel extending arms of the pick-up devices have the same length, characterized in that each arm encloses an obtuse angle with the centre line of the associated pick-up device and encloses with a plane of projection perpendicular to the centre line of the pick-up device an acute angle, which forms part of the obtuse angle, while during operation corresponding parts of the arms of two adjacent manipulators describe paths, which, viewed in projection, intersect each other in the said plane of projection.

3. A pick-up device which is rotatable about a centre line and is provided with an arm, which pick-up device is suitable for use in a positioning device as claimed in claim 2, characterized in that the arm encloses an obtuse angle with the centre line of the pick-up device and encloses with a plane of projection perpendicular to the centre line of the pick-up device an acute angle, which forms part of the obtuse angle.

Patentansprüche

1. Vorrichtung mit mindestens zwei Manipulatoren mit parallelen Mittellinien, die mittels eines Kopplungsglieds gleichzeitig um die Mittellinien drehbar sind, wobei jeder Manipulator mit einem mit dem Kopplungsglied schwenkbar verbundenen Arm versehen ist, während die sich parallel zueinander erstreckenden Arme der Manipulatoren die selbe Länge haben, dadurch gekennzeichnet, daß jeder Arm mit der Mittellinie des zugeordneten Manipulators einen stumpfen Winkel und mit einer zur Mittellinie des Manipulators senkrechten Projektionsebene einen spitzen Winkel bildet, der ein Teil des stumpfen Winkels ist, wobei einander entsprechende Punkte der Arme zweier nebeneinander angeordneter Manipulatoren im Betrieb Bahnen beschreiben, die sich - in Projektion gesehen - in vorgenannter Projektionsebene überschneiden.
2. Ausrichtvorrichtung zum Anbringen elektrischer Bauteile auf einem Träger mit mindestens zwei Aufnehmern mit parallelen Mittellinien, die mittels eines Kopplungsglieds gleichzeitig um die Mittellinien drehbar sind, wobei jeder Aufnehmer mit einem mit dem Kopplungsglied schwenkbar verbundenen Arm versehen ist, während die sich parallel zueinander erstreckenden Arme der Aufnehmer die selbe Länge haben, dadurch gekennzeichnet, daß jeder Arm mit der Mittellinie des zu-



a greater distance ($L1 = L2$).

In the embodiment described above of a device according to the invention, the manipulators are constituted by pick-up devices. However, the manipulators may also comprise tools, sensors, carriers of pins etc., by which accurate angular rotations must be performed. For this purpose, known manipulators may be used, which, after having been provided with a suitable arm, are suitable for use in a device according to the invention.

The centre lines of the manipulators need not absolutely be located in the same plane, as in the embodiment shown. For example, the parallel centre lines may be arranged in a triangle. Instead of by a coupling rod, the coupling member may then be constituted by a coupling plate, which is pivotably connected to the arms of the manipulators.

The pick-up device in the embodiment shown picks up components by means of subatmospheric pressure produced in the duct. The pick-up device could also pick up components by means of grippers.

The movement of the pick-up device in the holder in the direction of the arrow 49 may be omitted when the pick-up devices simultaneously pick up or place components and there is no risk of collision.

The auxiliary coupling rod in the embodiment of a device according to the invention assists the coupling rod in passing through a dead position of the coupling rod. However, this may also be realized by known means. If the rotation of the manipulators is limited to a part of a complete rotation and a dead position of the coupling rod is not reached, mechanisms for passing through the dead position may be omitted. Thus, the device is simplified.

Claims

1. A device comprising at least two manipulators, which have parallel centre lines and can rotate simultaneously by means of a coupling member about the centre lines, each manipulator being provided with an arm pivotably connected to the coupling member, while the parallel extending arms of the manipulators have the same length, characterized in that each arm encloses an obtuse angle with the centre line of the associated manipulator and encloses with a plane of projection perpendicular to the centre line of the manipulator an acute angle, which forms part of the obtuse angle, while during operation corresponding points of the arms of two adjacent manipulators describe paths, which, viewed in projection, intersect each other in the said plane of projection.
2. A positioning device suitable for placing electrical components on a support, comprising at least two pick-up devices which have parallel centre

lines and can be rotated simultaneously by means of a coupling member about the centre lines, each pick-up device being provided with an arm pivotably connected to the coupling member, while the parallel extending arms of the pick-up devices have the same length, characterized in that each arm encloses an obtuse angle with the centre line of the associated pick-up device and encloses with a plane of projection perpendicular to the centre line of the pick-up device an acute angle, which forms part of the obtuse angle, while during operation corresponding parts of the arms of two adjacent manipulators describe paths, which, viewed in projection, intersect each other in the said plane of projection.

3. A pick-up device which is rotatable about a centre line and is provided with an arm, which pick-up device is suitable for use in a positioning device as claimed in claim 2, characterized in that the arm encloses an obtuse angle with the centre line of the pick-up device and encloses with a plane of projection perpendicular to the centre line of the pick-up device an acute angle, which forms part of the obtuse angle.

Patentansprüche

1. Vorrichtung mit mindestens zwei Manipulatoren mit parallelen Mittellinien, die mittels eines Kopplungsglieds gleichzeitig um die Mittellinien drehbar sind, wobei jeder Manipulator mit einem mit dem Kopplungsglied schwenkbar verbundenen Arm versehen ist, während die sich parallel zueinander erstreckenden Arme der Manipulatoren die selbe Länge haben, dadurch gekennzeichnet, daß jeder Arm mit der Mittellinie des zugeordneten Manipulators einen stumpfen Winkel und mit einer zur Mittellinie des Manipulators senkrechten Projektionsebene einen spitzen Winkel bildet, der ein Teil des stumpfen Winkels ist, wobei einander entsprechende Punkte der Arme zweier nebeneinander angeordneter Manipulatoren im Betrieb Bahnen beschreiben, die sich - in Projektion gesehen - in vorgenannter Projektionsebene überschneiden.
2. Ausrichtvorrichtung zum Anbringen elektrischer Bauteile auf einem Träger mit mindestens zwei Aufnehmern mit parallelen Mittellinien, die mittels eines Kopplungsglieds gleichzeitig um die Mittellinien drehbar sind, wobei jeder Aufnehmer mit einem mit dem Kopplungsglied schwenkbar verbundenen Arm versehen ist, während die sich parallel zueinander erstreckenden Arme der Aufnehmer die selbe Länge haben, dadurch gekennzeichnet, daß jeder Arm mit der Mittellinie des zu-



geordneten Aufnehmers einen stumpfen Winkel bildet und mit einer zur Mittellinie des Aufnehmers senkrechten Projektionsebene einen spitzen Winkel bildet, der einen Teil des stumpfen Winkels bildet, wobei einander entsprechende Punkte der Arme zweier nebeneinander angeordneter Manipulatoren im Betrieb Bahnen beschreiben, die sich - in Projektion gesehen - in dieser Projektionsebene überschneiden.

3. Um eine Mittellinie drehbarer Aufnehmer mit einem Arm, welcher Aufnehmer zur Verwendung in einer Ausrichtvorrichtung nach Anspruch 2 geeignet ist, dadurch gekennzeichnet, daß der Arm mit der Mittellinie des Aufnehmers einen stumpfen Winkel bildet und mit einer zur Mittellinie des Aufnehmers senkrechten Projektionsebene einen spitzen Winkel bildet, der einen Teil des stumpfen Winkels bildet.

aigu faisant partie de l'angle obtus, alors que lors du fonctionnement, les parties correspondantes des bras de deux manipulateurs adjacents décrivent des trajets qui, vus en projection s'entrecoupent dans ledit plan de projection.

3. Dispositif de préhension pouvant tourner autour d'un axe géométrique et muni d'un bras, lequel dispositif de préhension est approprié à être utilisé dans un dispositif de positionnement comme revendiqué dans la revendication 2, caractérisé en ce que le bras forme un angle obtus avec l'axe géométrique du dispositif de préhension et un angle aigu avec un plan de projection perpendiculaire à l'axe géométrique du dispositif de préhension, l'angle aigu faisant partie de l'angle obtus.

Revendications

1. Dispositif comprenant au moins deux manipulateurs présentant des axes géométriques parallèles et pouvant tourner simultanément à l'aide d'un élément d'accouplement autour des axes géométriques, chaque manipulateur étant muni d'un bras relié de façon à pouvoir pivoter à l'élément d'accouplement, alors que les bras s'étendant parallèlement des manipulateurs présentent la même longueur, caractérisé en ce que chaque bras forme un angle obtus avec l'axe géométrique du manipulateur associé et forme un angle aigu avec un plan de projection perpendiculaire à l'axe géométrique du manipulateur, l'angle aigu faisant partie de l'angle obtus, alors que lors du fonctionnement, les points correspondant de deux manipulateurs adjacents décrivent des trajets qui, vus en projection, s'entrecoupent dans ledit plan de projection.

2. Dispositif de positionnement pouvant être utilisé pour la mise en place de composants électriques sur un support, comprenant au moins deux dispositifs de préhension présentant des axes géométriques parallèles et pouvant tourner simultanément à l'aide d'un élément d'accouplement autour des axes géométriques, chaque dispositif de préhension étant muni d'un bras relié de façon à pouvoir pivoter à l'élément d'accouplement, alors que les bras s'étendant parallèlement des dispositifs de préhension présentent la même longueur, caractérisé en ce que chaque bras forme un angle obtus avec l'axe géométrique du dispositif de préhension associé et forme un angle aigu avec un plan de projection perpendiculaire à l'axe géométrique du dispositif de préhension, l'angle