

Description

System for populating component carriers with electric components

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The invention relates to a system for populating component carriers with electric components, the system having a transport path and at least two populating stations for the component carriers.

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It is generally usual to link together a number of automatic populating devices, each having a populating station, by means of a transport path which runs linearly. As a result, it is possible to keep a large range of different components ready, which are distributed to the various automatic populating devices. As a result, on the one hand subassemblies which need a large variety of different components can be completely populated without supply modules for the components having to be interchanged for this purpose.

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For narrow component carriers, the automatic populating device can have two transport paths lying closely beside one another and having two narrow populating stations lying correspondingly beside one another, on which population can be carried out continuously and alternately.

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On the other hand, however, it is also possible to populate a large number of different subassemblies of small batch size with a low outlay on retooling. In this case, however, it may occur that subassemblies having a low number of components have to pass through only one or a few automatic devices in order to be able to be populated completely. Since these subassemblies also pass through the unnecessary populating stations in approximately the same cycle, the capacity of said stations cannot be utilized to the full extent.

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In assembly technology, it is generally usual to lead transport paths past the work stations and, at

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these points, to move the workpieces to be processed
out and in again,

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in order to make it possible to feed the workpieces as desired to the workstations, but this increases the outlay on time for the changing operations. In population technology, in addition to high flexibility, 5 a high populating throughput is also required.

In the conventional automatic populating devices, the transport paths and the populating stations overlap. It is usual in an automatic populating device to form the transport path from three 10 partial transporting means decoupled from one another. The populating station largely overlaps the central partial transporting means, which is stopped during the populating operation, while, for example, the preceding partial transporting means is bringing up the next 15 printed circuit board. In order to center the printed circuit board to be populated in the populating area, only a simple linear advancing movement is needed.

The invention is based on the object, in a populating units linked together in series and having a 20 high populating throughput, of being able to produce subassemblies with considerably different population contents.

This object is achieved by the invention according to claim 1. Arranging two paths makes it 25 possible to operate the populating units optionally in series or in parallel without retooling. For example, printed circuit boards for a low number of components can be transported independently of one another at any desired point from the conveying path onto the 30 transport path and, after passing through the populating station, can be moved back again to the conveying path. This makes it possible for a number of such subassemblies to be populated in parallel with one another, without any loss of capacity.

35 Subassembly carriers for a high number of components can, as before, [lacuna] from populating station

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to populating station method with low changeover times and at a high cycle rate and can have recourse to their supply of components.

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However, mixed operation is also possible, in which, for example, a subassembly carrier passes only through two successive populating stations. It is also possible for the transfer devices to be arranged
5 upstream or downstream of each second populating station, which reduces the mechanical outlay but also the flexibility. Such an arrangement is indicated in particular in automatic populating devices which have two populating stations located immediately one behind
10 the other.

Advantageous developments of the invention are identified in the subclaims:

In the development according to claim 2, the component carrier can be changed between the two paths
15 by means of simple lateral displacement. At the same time, it is possible to lead the conveying path through the automatic populating devices directly beside the transport path, or also to lead it past to the side of the automatic populating devices, for which purpose a
20 correspondingly large-stroke transfer device is necessary.

As a result of the development according to claim 3, the horizontally located subassembly carriers can be changed by means of vertical displacement. The
25 overall width of the automatic populating devices remains correspondingly smaller in this case. For narrow component carriers, as previously two closely adjacent transport paths and two correspondingly arranged conveying paths can be provided. Given a
30 transfer device configured with a large stroke, the conveying path can run above or underneath the automatic populating devices or device.

The development according to claim 4 permits a a space-saving arrangement of the conveying path. In
35 particular, the arrangement above the automatic populating devices has the advantage that the conveying

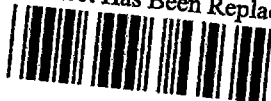
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path can largely be decoupled from the latter. As a result, the automatic populating devices, without changing their design,

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can be used as desired both for single-track and for two-track operation.

The development according to claim 5 makes it possible to arrange the populating station on the upper
5 side of the automatic populating device such that it is easy to see and is accessible.

The development according to claim 6 means that the transfer device is combined with the partial transporting means to form one unit, which permits
10 rapid and accurate transfer of the subassembly carriers.

The transfer device according to claim 7 makes it possible to insert the two partial transporting means simultaneously into both paths and operates the
15 latter simultaneously and independently of one another, with the exception of the changing operations.

Arranging the conveying path along the underside of the automatic populating devices according to claim 8, although it needs a large displacement
20 travel, makes it possible to use the automatic populating devices which are equipped only for single-track operation in unchanged form. As a result of the independence of the displacement drives, it is possible to briefly reclose the gaps produced in the paths.

25 The partial transporting means according to claim 9 require a low outlay on guidance and drive, and are in particular suitable for systems having a small distance between the two paths.

The development according to claim 10 means
30 that the transfer devices can be integrated into the automatic populating devices, so that the lines comprising a number of automatic devices can be formed simply by lining up the automatic populating devices in a row.

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The automatic populating devices according to claim 11 can be used at any desired point on the line, but in particular at its start and end as well.

5 The transfer device according to claim 12 makes it possible to achieve a conveying path which also runs outside the automatic populating devices, in particular underneath them.

10 The arrangement according to claim 13 permits further disentanglement of the transport system, with corresponding simplification of the control means, as a result of which, for example, it is possible to dispense with optical scanning devices in the region of the transfer device to distinguish between incompletely and completely populated component carriers. In this
15 case, it is advantageous if the transfer device has two partial transporting means which can be displaced independently of each other for the two parallel paths.

The system according to claim 14 makes it possible to lead the component carrier out of the
20 transport path without changing its relative position in relation to the respective partial transporting means. During this time, the gap produced is closed by the other partial transporting means for further transporting operations, the carrier according to claim
25 15 reducing the outlay in design terms.

The conveying path according to claim 16 likewise permits two-track operation in a space-saving manner, without the automatic populating devices having to be changed for this purpose, which can be
30 implemented in particular with the aid of the bottom parts according to claim 17.

The arrangement according to claim 18 requires an appropriate design modification of the previously single-track automatic populating device. Installation
35 space for the conveying path has to be conceived in its chassis, it being possible for this space to be

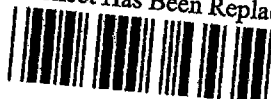
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arranged at a relatively small distance under the transport path, so that the displacement travel and the changeover times can be reduced considerably.

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An automatic populating device of this type can be delivered with or without an additional conveying path, depending on the customer's request. In addition, it is readily possible to re-equip an automatic
5 populating device already delivered with the conveying path, as required.

The invention will be explained in more detail below using exemplary embodiments that are illustrated in the drawing, in which, in schematic form:

- 10 Figure 1 shows a plan view of a system for populating component carriers with electric components,
Figure 2 shows a plan view of the system of Figure 1 in a different setting,
Figure 3 shows a side view of a further system for
15 populating component carriers, and
Figure 4 shows a further side view of another system.

According to Figure 1, a system for populating component carriers 1 has three automatic populating devices 2 arranged one after another in a row, in which
20 a populating head can be moved over a populating station 4, to which the component carriers 1 can be transported. The system has two separate paths, located beside each other, for transporting the component carriers 1. One of the paths is designed as a transport
25 path 5, which leads over the populating stations 4 located one after another in a row. The other path is a pure conveying path 6, which is led past the populating stations 4 directly beside the transport path 5.

The two paths are subdivided into a number of
30 sections which can be operated independently of one another, the sections located upstream and downstream

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of the populating station being designed as partial transporting means 7 which can be displaced transversely with respect to the transport direction in the populating plane. Of these means, in each case two partial transporting means 7 located beside each other and belonging to the transport path 5 and the conveying path 6 are fixed to a common carrier 8, which can be displaced transversely to the transport direction by the distance between the two paths, and forms a transfer device. This makes it possible to insert the respective partial transporting means assigned to the transport path in alignment into the conveying path, as is illustrated at the left-hand end of the conveying path 6.

A component carrier standing ready in the preceding section can now be transferred to the partial transporting means by driving these two sections, and can be transferred into the transport path by pushing the carrier 8 with the two partial transporting means back. In the converse sequence, such a component carrier can be moved out of the transport path 5 to the conveying path 6, as is indicated at the right-hand end of the transport path 5. Displacement operations of this type are possible in all the partial transporting means, so that the subassembly carriers can be inserted into the transport plug and returned to the conveying path at any desired location.

The movement arrows illustrated in Figure 1 show the corresponding displacement, driving and transport directions. Here, the various component carriers 1 are transferred at the start of the transport path and pass through the individual populating stations on a direct route, so that corresponding changeover operations are omitted.

In the operating mode illustrated in Figure 2, the component carriers 1 are not processed in line but in parallel. In this case, the component carriers 1 are

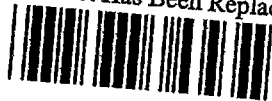
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populated completely at only one populating station 4 in each case, and are in each case moved into the transport path 5 upstream of the populating station 4 and,

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immediately after this, are returned into the conveying path 6 again. This operating mode is particularly suitable for component carriers (1) which have to be populated with a low number of components.

5 According to Figure 3, the transport path 5 is arranged above the conveying path 6 instead of beside it. A different carrier 9 for two of the partial transporting means 7 in each case can accordingly be displaced in the vertical direction by the distance
10 between the two paths. As a result, the component carriers 1 can be transferred alternately between the two paths in a manner similar to that in the system according to Figures 1 and 2. The free distance between the two paths is here the maximum height of the
15 populated subassembly carrier 1, so that the displacement travels are correspondingly short. In the case of this arrangement, the populating station 4 is located on the upper side of the paths, so that the populating head 3 can place the components 10 onto the
20 component carrier 1 in an unimpeded manner and with good access.

 According to Figure 4, the conveying path 6 runs underneath the automatic populating devices 2, whose bottom parts 11 have accordingly been raised.
25 This has the advantage that the automatic populating devices 2 can remain unchanged. Arranged between two successive automatic populating devices in each case are two additional partial transporting means 7, which can be displaced vertically and which are combined into
30 one structural unit (not illustrated). In the normal case, they are aligned with the transport path 5 or the conveying path 6, as is illustrated on the left-hand side of the system.

 In this case, the lower partial transporting
35 means 7 can be displaced between the conveying path 6 and the transport path 5, and can thus change component carriers 1 between these paths. The upper partial

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transporting means 7 is deflected upward only to such an extent that sufficient space remains for the populated component carriers 1 located underneath. These two partial transporting means 7 can therefore be
5 displaced independently of each other.

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Patent claims

1. A system for populating component carriers (1) with electric components (10), the system having at least one transport path (5) and at least two populating stations (4) for the component carriers (1), it being possible for the component carriers on the transport path (5) to be transported to one of the populating stations (4) and from there, essentially linearly, to the other populating station (4) and away from the latter, characterized in that the system has at least two separate paths, essentially running in parallel in the same transport direction, for transporting the component carriers (1), of which one forms the transport path (5) and the other is led past the populating stations (4), and in that, as viewed in the transport direction, transfer devices (e.g. 7, 8, 9) are arranged on both sides of the populating stations (4), by means of which the component carriers (1) can be transferred from one path to the other and vice versa.
2. The system as claimed in claim 1, characterized in that the transport path (5) and the conveying path (6) are designed as linear transporting means which are arranged in parallel beside each other in one plane.
3. The system as claimed in claim 1, characterized in that the transport path (5) and the conveying path (6) are designed as linear transporting means which are arranged in parallel one above the other at a distance.
4. The system as claimed in claim 3, characterized in that the conveying path (6) runs above the transport path (5), in particular above the automatic populating devices (2).



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5. The system as claimed in claim 4,
characterized
in that the transport path (5) is arranged at the level
of the populating station (4), and
- 5 in that the conveying path (6) runs underneath the
transport path (5).
6. The system as claimed in one of the preceding
claims,
characterized
- 10 in that the linear transporting means is subdivided
into a number of successive sections that can be driven
independently of one another,
in that the transfer device (e.g. 7, 8, 9) is assigned
to one of the sections, and
- 15 in that said transporting means is designed as a
partial transporting means (7) which can be displaced
between the two paths.
7. The system as claimed in claim 6,
characterized
- 20 in that the transfer device is formed as two partial
transporting means (7), which are at least temporarily
aligned with the paths.
8. The system as claimed in claim 7,
characterized
- 25 in that the two partial transporting means (7) can be
displaced independently of each other.
9. The system as claimed in claim 7,
characterized
in that the two partial transporting means (7) are at a
- 30 fixed distance from each other and are held on a common
carrier (8, 9) which can be displaced transversely with
respect to the paths.
10. The system as claimed in one of the preceding
claims,
- 35 characterized
in that the populating stations (4) are arranged in
separate automatic populating devices (2) in the
system, and

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in that the transfer device (e.g. 7, 8, 9) is assigned to the automatic populating device (2).

11. The system as claimed in claim 10, characterized

5 in that the automatic populating device (2) has one of the transfer devices (e.g. 7, 8, 9) in each case upstream and downstream of the populating station (4).

12. The system as claimed in claim 10, characterized

10 in that the transfer device is designed as a separate structural unit, which is arranged between the two automatic populating devices (2).

13. The system as claimed in one of the preceding claims,

15 characterized

in that the conveying path is subdivided into two parallel paths running parallel to each other, of which one carries a not yet completely populated component carrier and the other carries the already populated

20 component carrier, and

in that the transfer device can also be displaced horizontally, in addition to the vertical direction, to optionally drive both parallel transporting means.

14. The system as claimed in one of the preceding
25 claims, characterized

in that the partial transporting means (7) can be displaced transversely with respect to the transport direction,

30 in that a further partial transporting means (7) which can be displaced in the same direction is arranged in parallel beside this partial transporting means (7), and

35 in that the two partial transporting means (7), which can be driven independently of each other, can alternately be aligned flush with the adjacent section of the transport path (5).





15. The system as claimed in claim 16,
characterized

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in that the two partial transporting means are held on a common carrier (8, 9), which can be displaced transversely with respect to the transport direction by the distance between the two partial transporting means
5 (7).

16. The system for populating component carriers (1) with electric components (10), automatic populating devices (2), linked in a line, for the component carriers (1) being provided with
10 populating stations (4),
a transport path (5) for the component carriers (1) in the automatic populating device (1) running at the height of the populating station (4),
a second path for transporting the component carriers
15 (1) being designed as a conveying path, which runs past the populating station (4) underneath the transport path, in particular as claimed in claim 4,
characterized

in that the conveying path (6) runs underneath a
20 chassis of the automatic populating device (2), and
in that, at least in the region of the conveying path (6), the chassis has a bottom clearance which corresponds to the height of the linear transporting means plus that of the populated component carrier (1).

25 17. The system as claimed in claim 16,
characterized
in that the bottom parts (11) of the chassis are higher than the linear transporting means with the populated component carrier.

30 18. An automatic populating device for populating component carriers (1) with electric components (10), the automatic populating device (1) having at least one populating station (4),
a transport path (5) for the component carriers (1) in
35 the automatic populating device (1) running at the height of the populating station (4),
a second path for transporting the component

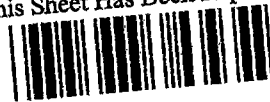
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carriers (1) being designed as a conveying path, which is led past the populating station (4), in particular as claimed in claim 5,

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characterized

in that the conveying path (6) runs at a short distance underneath the linear transporting means of the transport path (5), and

- 5 in that a chassis of the automatic populating device has accommodating and fixing means for the optional accommodation of the transport path.

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