



Description



G00002

Device for electrolytically treating board-shaped workpieces, in particular printed-circuit boards

5

EP-A-0 421 127 has disclosed a device for treating printed-circuit boards, in which the individual printed-circuit boards are guided continuously, in a vertically suspended position on a horizontal conveyor path, through successive treatment baths. The printed-circuit boards are conveyed through the treatment baths, which are accommodated in treatment cells, by means of clamps which are arranged on endlessly rotating drive mechanisms and which, in the case of electrodeposition of metal, are simultaneously also responsible for making cathodic contact with the printed-circuit boards. There are vertical slots for the printed-circuit boards to pass through in the end walls of the treatment cells, seals which are designed as brush seals or strip brush seals being provided in the passage region. The individual treatment cells are arranged in collection troughs, from which the collected bath liquid is continuously returned to the associated treatment cells with the aid of suitable pumps. The bath liquid is returned to a treatment cell via a feed line which is connected on the pressure side to the associated pump and the opening of which lies in an end wall, below the vertical slot for the printed-circuit boards to pass through and is directed horizontally into the treatment cell. In this way, the bath liquid flowing in is to be distributed uniformly to both sides of the printed-circuit boards.

US-A-4 401 522 has disclosed a similar device for the electrolytic treatment of workpieces, such as for example printed-circuit boards, in which the vertical slots in the end walls of the treatment cells are assigned pairs of vertically arranged rolls as seals. Bath liquid is returned to a treatment cell

in this case via two rows of vertically oriented spray tubes which are arranged on both sides of the conveyor path and are each provided in the longitudinal direction with a row of spray openings directed at the workpieces. The spray tubes are supplied via a distribution chamber which is formed in the bottom region of the treatment cell and for its part is supplied with bath solution from the collection trough via the pump.

10

US-A-5 827 410 has disclosed a further device for the electrolytic treatment of board-shaped workpieces, in particular printed-circuit boards, in which the board-shaped workpieces are guided in a vertical position, on a horizontal conveyor path, through a treatment cell, which contains a treatment bath and the end walls of which have vertical slots for the workpieces to pass through, with the aid of contact-making and conveyor means. The bath liquid which emerges from the treatment cell is collected in a collection trough and is returned to the treatment cell with the aid of a pump in such a manner that an at least substantially vertical direction of flow results on both sides of the conveyor path. The bath liquid is diverted toward the surface of the workpieces by diverting devices arranged on both sides of the conveyor path in the treatment cell. The diverting devices result in improved ion exchange in the region of the workpieces. Therefore, for example during the electrodeposition treatment of printed-circuit boards, the deposition of metal can be performed with relatively high current densities. The diverting devices are in this case arranged in such a manner that they form a guide for the workpieces.

35

In the device which is known from US-A-5 827 410, the bath liquid which rises on both sides of the workpieces can in part flow away laterally. As a result, depending on the height of the board-shaped workpieces, the

result may be insufficient flow arriving from the lateral direction, and therefore insufficient ion exchange, in the upper region of the workpieces. If

the current density is then not reduced, the insufficient ion exchange leads to burning in the upper region of the workpieces. Consequently, high current densities cannot be used for electrodeposition without
5 blowing in considerable amounts of air or gas, for example. The considerable turbulence which is brought about by additionally blowing considerable amounts of air or gas onto the boards can cause thin workpieces to bend and possibly become jammed in the diverting
10 devices. Another negative consequence of blowing in considerable amounts of air or gas is an increased consumption of additives.

The invention which is described in claim 1 is based on
15 the object of providing a device for electrolytically treating vertically oriented board-shaped workpieces in which, by simple means, medium can be made to flow uniformly onto the entire surface of both sides of the workpieces passing through.

20 The advantages achieved by the invention consist in particular in the fact that, in the region of the spray tubes, lateral flow onto the workpieces passing through which is completely independent of other influences is
25 ensured. The inclination of the spray tubes with respect to the horizontal on the one hand prevents strip-like coverage of the field lines between electrodes and workpieces and, on the other hand, ensures particularly uniform flow onto the workpieces.
30 The improved ion exchange which is achieved as a result of this uniform flow means that the current densities of the electrolytic treatment can be increased considerably even for relatively high workpieces. Moreover, in most cases, it is possible to completely
35 dispense with the step of blowing in additional air or gas.

Advantageous configurations of the invention are given in the subclaims.

The configuration according to claim 2 allows the simultaneous use of the spray tubes as a guide for the board-shaped workpieces.

5 According to claim 3, bath liquid can be returned to the treatment cell partially via the spray tubes and partially via a distribution chamber formed in the bottom region of the treatment cell. In this case, it is also possible, in accordance with claim 4, for
10 diverting devices to be arranged on both sides of the conveyor path in the treatment cell in the lower region of the workpieces, which diverting devices divert the bath liquid which flows upward out of the distribution chamber toward the surface of the workpieces. In this
15 case, there is no need to provide spray tubes in the lower region of the workpieces.

The refinement described in claim 5 allows the angle of incidence of the flow of liquid directed from the spray
20 tubes onto the workpieces to be flexibly adjusted. As a result, the angle of incidence can be set optimally for each workpiece.

As described in claim 6, angles of inclination of
25 between 5° and 30° have proven particularly suitable for the inclination of the spray tubes with respect to the horizontal. Optimum results and a particularly uniform flow onto the workpieces are achieved at angles of inclination of between 5° and 15°, in accordance
30 with claim 7.

The refinement described in claim 8 makes it particularly easy to secure the spray tubes within the treatment bath. The supports which are used to secure
35 the spray tubes can then, as described in claim 9, be spanned by a nonwoven or cloth which is permeable to the bath liquid. In this way, particularly effective electrolyte movement can be achieved in the region between supports and workpieces.

Exemplary embodiments of the invention are illustrated in the drawing and are described in more detail below. In the drawing:

- 5 Figure 1 and Figure 2 show highly simplified, diagrammatic illustrations of a device for electrolytically treating board-shaped workpieces, in plan view and cross section, respectively,
- 10 Figure 3 shows a cross section through a first embodiment of the treatment cell of a device shown in Figures 1 and 2,
- 15 Figure 4 shows a cross section through a second embodiment of the treatment cell of a device shown in Figures 1 and 2, and
- 20 Figure 5 shows a plan view of the inclined spray tubes of the treatment cell illustrated in Figure 4.

Figures 1 and 2 show a plan view and a cross section, respectively, of a treatment cell BZ which is arranged
25 in a collection trough AW, contains an electrolytic treatment bath and through which board-shaped workpieces W, which are suspended vertically from contact-making and conveyor means KT, are guided on a horizontal conveyor path TW. At both end walls of the
30 treatment cell BZ there are lock chambers SK, in which seals D, which are formed by cylindrical plastic tubes, are arranged in pairs and loosely in a vertical orientation. These seals D are pressed onto one another or onto the workpiece W passing through in each case by
35 the pressure of the bath liquid. The end walls of the treatment cells BZ, of the lock chambers SK and of the collection trough AW are provided with vertical slots S, through which the board-shaped workpieces W can be guided without being impeded. The bath liquid which

emerges from the treatment cell BZ in the region of the lock chambers SZ and possibly also overflows the walls of the treatment cell BZ is collected in the collection trough AW and is

continuously returned to the treatment cell BZ by means of a pump P, as indicated by an arrow PF1 in Figure 2.

5 In the treatment cell BZ, electrodes (not shown), which have the opposite polarity to the contact-making and conveyor means KT, are arranged on both sides of the conveyor path TW. In the case of electrodeposition of metal on the workpieces W, cathodic contact is made with the workpieces W via the contact-making and
10 conveyor means KT, while the electrodes which are yet to be explained in more detail with reference to Figures 3 and 4 are anodes. In the case of pulsed electrodeposition, the electrodes are alternately connected as anodes and cathodes.

15

The abovementioned returning of bath liquid into the treatment cell BZ takes place in part via a distribution chamber VK, as indicated by the arrow PF1 in Figure 2. This distribution chamber VK, which is
20 formed in the bottom region of the treatment cell BZ by an intermediate base ZB, is provided with two rows of openings O, which are formed in the intermediate base ZB on both sides of the conveyor path TW. Then, the bath liquid which is conveyed by the pump P partially
25 into the distribution chamber flows upward through these openings O, with a vertical direction of flow, on both sides of the workpieces W, as indicated by the arrows ST in Figure 2. The bath liquid flowing upward is then diverted toward the surface of the workpieces W
30 by diverting devices (not shown in Figures 1 and 2) or alternatively by spray tubes. Various possible ways of designing the treatment cells BZ and of arranging the diverting devices and spray tubes in the treatment cells BZ are described in more detail below with
35 reference to Figures 3 and 4.

Figure 3 shows a first embodiment of a treatment cell BZ, with electrodes arranged on both sides of the

conveyor path TW (cf. Figure 1) for the workpieces W,
which electrodes

are soluble anodes A1. In the case of electrodeposition of copper, the soluble anodes A1 comprise, for example, titanium baskets and balls of copper accommodated therein. Diverting devices LV, which are formed by
5 semicircular profiled sections arranged at a vertical distance from one another and inclined in each case at an angle of 10° with respect to the horizontal, are arranged on those sides of the soluble anodes A1 which face the workpieces. The diverting devices LV, which
10 consist, for example, of high molecular weight PE, are arranged alternately on either side of the workpieces W, as seen in the vertical direction, i.e. each diverting device LV on one side is situated exactly half way between two diverting devices LV on the
15 opposite side. Moreover, the distance between the diverting devices LV on both sides is such that a guide is formed for the board-shaped workpieces W passing through.

20 A horizontally oriented distribution tube VR, which is connected on the pressure side to the pump P (cf. Figure 2), is located in the bottom region of the treatment cell BZ, in the distribution chamber VK formed by the intermediate base ZB. This distribution
25 tube VR is provided on its underside with holes which are arranged at a distance from one another and from which the bath liquid emerges, as indicated by the arrows PF2 in Figure 3. As has already been explained in connection with Figure 2, the bath liquid then flows
30 upward into the treatment cell BZ with a vertical direction of flow ST on both sides of the workpieces W passing through. The upwardly flowing bath liquid is then once again diverted toward the surface of the workpieces W by the diverting devices LV. The overall
35 result, on both sides of the workpieces W, is in each case a meandering flow with, in each case in the region of a diverting device LV, horizontal flow components which are directed at the surface of the workpieces W. As a result of the alternating arrangement of the

diverting devices LV, when perforated printed-circuit boards are being treated there is very good flow of medium through the through-contact holes in these boards.

To then achieve effective ion exchange in the upper region of the workpieces W passing through as well, spray tubes SR are arranged on both sides of the conveyor path TW instead of the diverting devices LV in this upper region (cf. Figure 1). These spray tubes SR, in the same way as the guide devices LV, are in each case inclined at an angle of 10° . The spray tubes SR, which are likewise connected on the pressure side to the pump P (cf. Figure 2) are provided with a multiplicity of outflow openings, which cannot be seen in Figure 3 and from which the bath liquid flows onto the workpieces W, as indicated by arrows PF3 in Figure 3. It can also be seen from Figure 3 that the spray tubes SR, which consist, for example, of PVC, are arranged in such a manner that, in the same way as the diverting devices LV, they form a guide for the board-shaped workpieces W passing through.

Figure 4 shows a second embodiment of a treatment cell BZ with electrodes arranged on both sides of the conveyor path TW (cf. Figure 1) for the workpieces W. The electrodes, which are merely indicated by dashes A2 in Figure 4, are once again soluble anodes which correspond to the anodes A1 illustrated in Figure 3. Between the soluble anodes A2 and the workpieces W passing through there are supports T, on the mutually facing inner sides of which there are spray tubes SR. In this context, reference is additionally made to Figure 5, which also illustrates the spray openings SO, which are arranged at regular intervals, of the spray tubes SR and the arrangement of the spray tubes SR which is inclined with respect to the horizontal. The angle of inclination which is denoted by α is, for example, 10° . The support T is spanned by a nonwoven V which can be seen from Figure 5 and is permeable to the bath liquid.

The individual spray tubes SR are in each case arranged in pairs, at the same height, on both sides of the

GR 99 P 5206

- 8a -

workpieces W passing through. The individual spray
tubes SR on each side

are connected, via T-pieces, which cannot be seen in more detail, to centrally arranged and vertically oriented supply tubes ZR, which for their part are connected on the pressure side to the pump P (cf. Figure 2). This supply of bath liquid from the pump is indicated by an arrow PF4 in Figure 5.

In addition to the distribution tube VR, an air-supply tube LR is also arranged in the distribution chamber VK of the treatment cell BZ illustrated in Figure 4, through which air-supply tube, if appropriate, compressed air can be introduced, which then rises upward between the spray tubes SR and the workpiece W. The bath liquid which is delivered from the distribution tube VR rises upward in the direction indicated by the arrows ST and is then diverted toward the surface of the workpieces W by means of the spray tubes SR, which are serving as diverting devices. Some of the bath liquid flowing upward is diverted laterally through the nonwoven V (cf. Figure 5), as indicated by arrows PF5 in Figure 4. The bath liquid which emerges from the spray tubes SR and flows onto the surface of the workpieces W is also indicated, again by arrows PF3, in Figure 4. In this case too, the spray tubes SR are arranged in such a manner that they form a guide for the workpieces W passing through.

In order also to allow optimization of the flow onto the workpiece surfaces via the spray tubes SR when different workpieces W are being electrolytically treated, the individual spray tubes SR can rotate about their longitudinal axes LA. This possibility of rotating the spray tubes SR is indicated by double arrows PF6 in Figures 4 and 5.

Patent Claims

1. A device for electrolytically treating board-shaped workpieces (W), in particular printed-circuit boards, having
- 5 - contact-making and conveyor means (KT), which make anodic or cathodic contact with the workpieces (W) and guide them in a vertical position on a horizontal conveyor path (TW) through at least one treatment bath,
 - 10 - a treatment cell (BZ) for holding the treatment bath,
 - electrodes which are arranged on both sides of the conveyor path (TW) in the treatment cells (BZ) and have the opposite polarity to the contact-making and conveyor means (KT),
 - 15 - vertical slots (S) in the end walls of the treatment cell for the workpieces (W) to pass through,
 - 20 - a collection trough (AW) for the bath liquid emerging from the treatment cell (BZ), and having
 - at least one pump (P) for continuously returning bath liquid from the collection trough (AW) to the treatment cell (BZ),
 - 25 characterized in that the bath liquid is returned at least in part via spray tubes (SR), which at least in the upper region of the workpieces (W) are arranged on both sides of the conveyor path (TW) in the treatment cell (BZ), the spray tubes
 - 30 (SR) extending in the direction of the conveyor path (TW) and being oriented at an angle with respect to the horizontal (H).
2. The device as claimed in claim 1, characterized in
- 35 that the spray tubes (SR) are arranged in such a manner that they form a guide for the workpieces (W).

3. The device as claimed in claim 1 or 2, characterized in that the returning of bath liquid to the treatment cell (BZ)

takes place partially via a distribution chamber (VK) formed in the bottom region of the treatment cell and via openings (O) in the distribution chamber (VK), which are arranged on both sides of the conveyor path (TW).

4. The device as claimed in claim 3, characterized in that diverting devices (LV), which divert the bath liquid which flows upward out of the distribution chamber (VK) toward the surface of the workpieces (W), are arranged on both sides of the conveyor path (TW) in the treatment cell (BZ) in the lower region of the workpieces (W).

5. The device as claimed in one of the preceding claims, characterized in that the spray tubes (SR) are arranged in such a manner that they can rotate about their longitudinal axis (LA).

6. The device as claimed in one of the preceding claims, characterized in that the spray tubes (SR) are inclined at an angle (α) of between 5° and 30° with respect to the horizontal (H).

7. The device as claimed in one of claims 1 to 5, characterized in that the spray tubes (SR) are inclined at an angle (α) of between 5° and 15° with respect to the horizontal (H).

8. The device as claimed in one of the preceding claims, characterized in that the spray tubes (SR) are arranged on supports (T) which are arranged between the workpieces (W) and soluble anodes (A2).

9. The device as claimed in claim 8, characterized in that the supports (T) are formed by frames which are spanned by permeable cloth or nonwoven (V).