

The invention relates to an arrangement according to the precharacterising clause of claim 1. The electrolytic application of copper, in particular, is considered in that arrangement. Such an arrangement is known from DE-OS 32 36 545 and has the advantage that the plate-shaped articles are continuously conveyed in the horizontal position through the chamber starting from the pretreatment station and, likewise remaining in the horizontal position, can be conveyed to the after-treatment station. In that known arrangement, however, the transport of the plate-shaped articles is relatively complicated and that solution is disadvantageous. The plate-shaped articles are gripped at their edges on both sides by rollers or wheels. The rollers or wheels provided at one side must be mounted in slotted guides against the action of a spring. This design is extremely involved and on account of its complexity is not only expensive but also susceptible to breakdown. The end edges of the rollers or wheels are formed in the shape of a meander so as to be able to conduct the current. There exists here the risk that when one contact point has been released and the next contact point of the rollers or wheels to the plate edge is not yet complete, arcing may occur. Since the end edges or circumferential faces of the rollers or wheels have to be moved along continuously over the plate edges, they may well be worn down in a relatively short period of time. The material to be applied to the plate-shaped articles by the electrolysis process is also applied to the rollers or wheels. These therefore always have to be changed for the coating to be removed and for them to be cleaned and remounted. This not only requires a corresponding assembly time with the consequent cost thereof, but also causes very disadvantageous interruptions in the operation of the arrangement itself. In addition there is the further disadvantage, involving considerable design expenditure, that each wheel or

roller has to have its own drive.

Starting from the precharacterising clause of claim 1, the aim of the invention is first of all to design transport means that are simpler and more robust than those of the described prior art, and also, especially, to improve in association therewith the conduction of current to the plate-shaped articles.

To meet that aim, starting from the precharacterising clause of claim 1, first of all the arrangement of features according to the characterising clause of claim 1 is provided. The continuously moving transport members grip the edges of the plate-shaped articles - the invention is concerned especially with the electrolytic metallisation of electric circuit boards for use in electronics - and move them through the electrolysis chamber. Apart from the beginning of the gripping and the beginning of the release, there is no relative movement between the transport members and the edges of the plates. Manifestations of wear or tear of the transport members are therefore avoided. After passing through the transport path inside the electrolysis chamber, the transport members are automatically released from the plate edge and, outside the electrolysis chamber, guided back until they reach the beginning of the transport path and automatically grip the edge of one of the plate-shaped articles again. This also simplifies and facilitates the drive of the transport members. It is not necessary for each individual transport member to be driven on its own, but, in accordance with a preferred arrangement of the invention (see claim 5), a continuously moving conveyor belt, to which all transport members are attached, is sufficient, so that only the conveyor belt has to be driven. A simple and robust design of the transport members is possible.

An arrangement of the invention that is especially simple and at the same time advantageous in its design and operation forms the subject of claim 3. Those clamp members have a strong clamping action, but as a result of the run-on rail the clamp members can be caused in a simple and simultaneously reliable manner to grasp hold of or release the plate-shaped articles.

The features of claim 7 serve to solve the problem mentioned specifically above of improving the conduction of current to the plate-shaped articles. This can be achieved by the transport members of the invention.

In order to avoid the disadvantages described in connection with the prior art, the features of claim 9 make use of the circulation of the transport and current-conduction members by means of a continuous belt in order, during movement of the transport and current-conduction members outside the transport path of the plate-shaped articles, that is to say outside the electrolysis chamber, to provide for the removal of metal, in this case preferably copper, applied during the electrolysis.

Further advantages and features of the invention are disclosed in the other sub-claims and in the following description and associated drawings of possible arrangements of the invention. In the drawings,

Fig. 1 shows: an essentially diagrammatic plan view of an arrangement according to the invention,

Fig. 2 shows: an arrangement of the invention that has been modified slightly by comparison with Fig. 1, in section

according to the line II-II of Fig. 1.

Fig. 1 shows diagrammatically, and on a smaller scale by comparison with Fig. 2, a plan view of an electrolysis chamber 1 to which the plate-shaped articles 2 are conveyed in the direction of the arrow 3 by transport means, not shown here, preferably from one or more pretreatment stations, also not shown in the drawing. The plate-shaped articles 2 thus enter in the direction of transport 3 at side 1' of the electrolysis chamber 1, pass through the chamber, and leave at side 1" which lies opposite side 1'.

Fig. 2 shows the electrolysis bath 6 inside the chamber 1. The bath surface 7 lies above upper anodes 8, which are disposed above the plate-shaped articles 2 and their transport path, whilst lower anodes 9 are arranged therebelow. The anodes 8,9 may be plates of the metal to be applied, preferably copper. Containers consisting of a material that cannot be removed by electrolysis (e.g. titanium) and which contain the metal to be applied, may, however, alternatively be provided. The upper anodes 8 can be lifted upwards and inserted from above in order to be changed. After switching off the device and after the volume of electrolyte has flowed out of the chamber into a collecting vessel from which the pump or pumps reconvey the electrolyte when operation recommences, it is possible, after removal of a sealing lid 10 in the left side-wall 11 of a subsidiary chamber 12, for the lower anodes 9 to be taken out in the direction of arrow 13. In the course of their removal they pass through a hole 14 in the chamber wall 15. Any electrolyte liquid emerging therefrom is collected in the subsidiary chamber 12 and is conveyed through the discharge pipe 16 thereof to a pump by means of which it is returned to the electrolysis bath 6 inside the vessel.

The current supplies to the anodes 8,9, which are in fixed position during operation, are not shown separately in the drawing. The supply of current to the plate-shaped articles forming the cathode, which are moved during operation, is effected in accordance with a preferred arrangement of the invention, which is described in detail hereinafter and illustrated in the drawing, by way of the transport means. A preferred arrangement of those transport means is described below:

The transport means are clamps, which in this example comprise two clamp members 17, 18, which by means of the pressure of a spring 19 are so pivoted about their mutual current-conducting point or attachment point 20 that their lower ends 21, 22 in Fig. 2 are pressed against each other by the spring pressure, and thus grasp the side edge of the plate-shaped article 2 in question, in this case a printed circuit board for electronic purposes. The clamp member 18 grips round a guide rail 23 and its end 26 is so guided in the latter that the clamp member slides along the rail. The part 27 of the clamp member 18 slides along a brush arrangement 29 which extends over the transport zone 28 (see Fig. 1) and, during that transport, all clamp members 18 that grip the plate-shaped articles 2 supply current of the relevant polarity.

Fig. 1 also shows how a relatively large number of clamps or clamp members 17,18 are arranged one after the other and spaced from one another on a continuous belt 31 which moves over the rollers 30. The drive belt 31 may be a plastics toothed belt or a plastics chain, the rollers 30 having a matching toothing. The guide rails 23 run all round, whilst a run-on rail 32 with a run-on face 33 extends only over the non-transport zone of the clamps,

that is to say from the ends of the transport zone 28 around the two drive rollers 30 and along the outer half 5 of the conveyor belt shown in Fig. 1. By contrast the respective inner half 4 of the drive belt 31 corresponds roughly to the transport zone 28. The run-on face 33 is so positioned with respect to a 90° offset end portion 34 of the clamp member 17 that it compresses the spring 19 and pushes that end portion into the position shown on the right in Fig. 2 in which the ends 21, 22 of the clamp members 17, 18 are separated from one another, that is to say in which they are no longer able to exert a clamping action on the plate-shaped article. Thus the plate-shaped articles are gripped by the clamps or clamp members 17, 18 after entering into the electrolysis chamber and are released again before they leave. During this passage through the chamber, as described the current is at the same time supplied to the plate-shaped articles through the clamp member 18. The drive for the guide rollers 30 is not shown separately. The springs 19 are each braced between the clamp member arms 34 and 39 disposed above the pivot point 20 in Fig. 2. This is a structurally simple and at the same time advantageous arrangement for producing the clamping force between the clamp member ends 21, 22. The two clamp members could also be arranged in such a manner as not to be pivotable about the point 20 with respect to each other; the pivot joint 20 could instead be omitted, the clamp member 17 made displaceable at right angles with respect to the clamp member 18 and a tension spring (not shown in detail), providing the pressing force, could be located at the position indicated by 19'. In that case, the tension spring presses the clamp member ends 21, 22 together. The clamp member ends are moved apart on leaving the transport zone by an appropriately shaped run-on face, also not shown. Fig. 2 also shows that the transport means are preferably so designed and arranged that all components at which

sliding movements and thus wear may occur are disposed to the side of the electrolysis vessel. This prevents abraded particles from falling into the bath and resulting in flawed areas in the metal deposited by the electrolysis. Such friction may occur between the clamp member arms 39 and the guide rail 23. For the purpose of collecting the particles, there is provided a collector sheet 40 which forms a collecting channel 41 above the surface 7 of the liquid in the bath 6 and in the demetallisation chamber 35 described below.

During the electrolysis process inside the bath 6, the metal in question is deposited on the clamp members 17, 18. It is therefore recommended that these be provided over their ends 21, 22 upwards to above the surface 7 of the liquid with a plastics coating (not shown) preventing such a deposit. In order to remove the metal deposited on the ends 21, 22 a further bath chamber (demetallisation chamber) 35 is provided, which is also filled with the electrolyte liquid (its surface 36 may be lower than the surface 7). As soon as the clamp members 17, 18 are located in that bath 35, they are supplied through a further brush arrangement 37 with a current of a polarity that is opposite to the polarity of the current supply through the brush arrangement 29. Both brush arrangements furthermore extend over the entire length of both halves 4,5 of the drive belt 31. The opposite pole is formed by a member 38 which projects into the bath 35. As a result, metal deposited on the ends 21, 22 is removed again electrolytically when the clamp members pass through the bath 35. If desired, demetallisation by chemical means would also be possible.

Fig. 1 shows that the transport and current-supply means described hereinbefore may be provided to the left and right of the electrolysis chamber, that is to say they

grip at both sides the plate-shaped articles which are passed through. This is necessary when very thin plates (foils) are to be treated. Fig. 2, on the other hand, shows that the transport and current supply means can also be provided at one side of the plate-shaped articles only. 42 indicates feed pipes for the electrolyte liquid.

All of the features described and illustrated, and combinations thereof, are inventive.

CLAIMS



1. Arrangement for the electrolytic application of a metal to plate-shaped articles, such as printed circuit boards, in which those articles are placed in an electrolysis bath for a predetermined residence time and then removed from the bath again, the plate-shaped articles being conveyed in a horizontal position to an electrolysis chamber forming the arrangement, conveyed continuously through that chamber and, after the electrolysis treatment, removed from the chamber again, anodes, current supplies and transport means being provided, characterised in that the transport means comprise a continuously moving, driven series of individual transport members designed in the form of clamps which, in the transporting position which extends over the transport zone (28), clamp round the edges of the plate-shaped articles and move in the direction of transport (3), the clamps consisting of two clamp members which are moved into the clamping position and exert the clamping force by means of spring pressure, and in that there are present at the beginning and at the end of the transport path (28) for the plate-shaped articles (2) that is located in the electrolysis chamber (1) means for opening the clamps against the spring pressure so that the plate-shaped articles can be gripped and released again, and in that the transport members are simultaneously used to supply current to the plate-shaped articles (2).

2. Arrangement according to claim 1, characterised in that a run-on face (33) of a run-on rail (32) is provided which extends over the non-transport zone of the transport member path and, by engaging against one or both of the clamp members, moves those members into the release position.

3. Arrangement according to claim 1 or 2, characterised



in that the clamps or clamp members (17,18) are guided on a continuous guide rail (23).

4. Arrangement according to any one of claims 1 to 3, characterised in that the transport members, especially in the form of the clamp members (17,18), are mounted spaced from one another on a continuously moving conveyor belt (31).

5. Arrangement according to any one of claims 1 to 4, characterised in that there is provided for each clamp member (17,18) a pressure spring (19) which is disposed above the pivot joint (20) of the two clamp members (17,18) and is braced between the upper arms (34, 39) of the clamp members.

6. Arrangement according to claim 1, characterised in that a stationary brush arrangement (29) is provided and bears against the clamps or clamp members.

7. Arrangement according to any one of claims 1 to 6, characterised in that there is provided for the transport members, especially in the form of clamp members (17,18), outside the transport zone (28), a further bath chamber (demetallisation chamber) (35) filled with electrolyte liquid, and that the transport members (17,18) receive a current supply there, also by way of a stationary brush arrangement (37) or the like, but the current has the opposite polarity to that of the current supply for the transport members disposed in the transport zone.

8. Arrangement according to claim 7, characterised in that the demetallisation chamber (35) has the function of a subsidiary chamber for receiving electrolyte liquid that escapes when the clamps or clamp members pass through on their way from or to the electrolysis chamber



(1).

9. Arrangement according to any one of claims 1 to 8, characterised in that the current supply and/or transport of the plate-shaped articles are provided at one or at both longitudinal sides of the transport path of the plate-shaped articles.

10. Arrangement according to any one of claims 1 to 9, characterised in that parts of the arrangement at which friction may occur when the transport members move are disposed to the side beyond chambers (6, 35) containing electrolyte liquid.