

ELECTROPLATING APPARATUS

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This invention relates to improvements in electroplating apparatus.

In prior arrangements, articles to be treated are often damaged due to shearing forces acting on the article being treated.

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It is an object of this invention to overcome this problem.

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In accordance with the invention, an electroplating apparatus comprises a conveyor arrangement to support articles for plating, and a series of electroplating treatment vessels adjacent to the conveyor arrangement, the conveyor arrangement being mounted and rotated about substantially horizontal axes, such that the conveyor arrangement moves in a substantially vertical plane, wherein the conveyor arrangement comprises at least one support structure made up of plurality of support members, each of which support members

20 holds a plurality of article contact members which are used to grip and secure the articles for plating, and wherein at least one of the contact members has a portion which overlaps with the corresponding portion of adjacent contact members such that any article being plated and supported by the contact members is held between the

25 overlapping portions of the contact member(s), the contact member(s) being movable between two positions, a first position where the contact member(s) is open and its overlapping portion not in

engagement with either the articles to be plated or adjacent contact members, and a second position where the contact member(s) is in a closed position and its overlapping portion in contact either with the article to be plated or adjacent contact members.

5 In such an arrangement, any article being plated and supported by the contact members in the form of fingers is held between the ends of the fingers without any shearing forces acting thereupon. This is because any force exerted on the article will act on the overlapping outer end of the adjacent fingers. This has the
10 advantage that the article will not be damaged (as is the problem in the prior art, since there is no overlapping feature in the prior art, and accordingly the shearing forces act completely on the article being plated, which leads to damage thereof).

 Preferably, some of the contact members are movable
15 in one direction, whilst the rest of the contact members are movable in the opposite direction. Advantageously, all the contact members movable in one direction are mounted on one component, and wherein all the other contact members movable in the other direction are mounted on another component, the two components being joined
20 together to form a support member. Suitably, the contact members are arranged to be movable in a direction which is opposite to the direction the adjacent contact members move.

 Preferably, the overlapping portions of the contact members overlap each other in a substantially vertical plane.

Advantageously, the contact members are arranged side by side, and are orientated to intersect each other in a substantially vertical plane.

In such an arrangement, one can also easily achieve increased capacity without having to substantially increase the size of the apparatus, since the conveyor arrangement will be vertically orientated and can thus support more than one support structure for articles for plating. In this regard, the space occupied by such a conveyor arrangement is substantially less than if the conveyor arrangement was orientated in a horizontal plane.

In particular, the conveyor arrangement suitably transports two series of support structures, each support structure being made up of plurality of support members for the articles being plated, which plurality of support members integrally incorporates a number of article contact members which are used to grip and secure the articles for plating. The advantage of providing a plurality of support members is that if one portion of the support structure becomes damaged for one reason or another, it is not necessary to replace the whole support structure, rather one only has to remove the particular offending support member, and replace this with a spare support member, whilst the original support member is repaired.

Suitably, the electroplating apparatus has a loading section, which section includes means to vacuum suck a plurality of articles to be plated one at a time from a stack onto an inserting

machine, whereafter the articles are inserted into a feeding mechanism, and finally the articles are pushed up from within this feeding mechanism up into contact with the "gripping" fingers which are synchronized to open and close at the appropriate time.

- 5 Preferably, the electroplating apparatus is also provided with an unloading section, which section receives articles (now plated) dropped down from the support members, and thereafter places the articles into stacks.

- 10 Such an arrangement has the advantage that the gripping finger mechanism will not damage the articles for plating since the shearing forces act through the gripping fingers, and not on the articles themselves. Furthermore, the arrangement has the advantage that a conveyor having a plurality of article support structures can be used without substantially increasing the size of the
- 15 apparatus, resulting in increased capacity. Finally, such a conveyor arrangement is much easier to repair since each support structure is broken up into a plurality of support members.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a side view of an electroplating apparatus in accordance with the invention;

Figure 2 is a cross-sectional view of the apparatus shown in Figure 1 along lines 2-2 of Figure 1;

Figure 3 is a perspective view of the gripping mechanism used with the apparatus shown in Figures 1 and 2;

Figure 4 is a schematic view of a loading apparatus used with the apparatus shown in Figures 1 to 3; and

Figure 5 is a schematic view of an unloading apparatus used with the apparatus shown in Figures 1 to 4.

In Figure 1, an electroplating apparatus 10 is shown with a plurality of standard treatment sections including pre-rinsing (see 11), electroplating (see 13) and neutralizing (see 15).

The arrangement is provided with a conveyor arrangement 12 which is orientated in a vertical plane, and particularly, which is mounted about two horizontal axes (see 14 and 16).

As will be seen from Figure 2, the conveyor has two article support structures (18 and 20) which are shown mounted in close proximity to each other and movable at all times within their own vertical planes, whereby with a single apparatus, one can

obtain at least double capacity since the apparatus can mount two support structures on a single conveyor.

In Figure 2, the conveyor arrangement is shown passing through a plating cell 21 (ie the electroplating treatment stage of the apparatus). Each support structure 18 and 20 has a number of support members 22 which are provided with contact members in the form of plurality of fingers 24 (see Figure 3). These fingers mount the article to be plated (see 26 in Figure 4), and transport these articles through the various electroplating treatment steps when the conveyor is moving.

Each support structure 18 and 20 is made up of a plurality of members (see Figure 3) rather than one continuous support mechanism, so that in the event that say one of the fingers 24 is damaged, there is only the need to remove one support member of the whole support structure (rather than the whole support structure) for repair, and in the meantime insert a replacement support member. As will be seen from Figure 1, a support member can be easily accessed and removed at each end of the conveyor.

The contact members 24 meanwhile are designed such that the outer ends of the fingers open on engagement of a lower portion (see 25) of each finger with a stationery cam (not shown), whereby articles to be coated can be placed in the gap between the fingers, and whereafter when the outer ends of the finger close (after passing the cam), they contact both sides of the articles

to be coated and thus hold the articles ready for coating. The outer end of each finger is also specially designed, so that the end overlaps (see 28) with the ends of the two adjacent fingers. The advantage of such an arrangement is
5 that the shearing forces exerted by the fingers at the ends are transferred through the article supported, and onto the overlapping ends of the adjacent fingers. This has the result that little or no shear forces are accordingly acted upon the articles to be coated (which has resulted in
10 damage in prior art arrangements).

As will be seen from Figure 3, the support member 22 is made of two independent components 22a and 22b, one component 22a incorporating all the fingers 24a which are orientated and deformed in one direction, and the other
15 component 22b containing all the fingers 24b which are orientated and deformed in the other direction, which two components are then placed and secured back to back, so that the arrangement shown in Figure 3 with overlapping fingers is achieved.

20 Other features of the apparatus will be seen from Figure 2, and in particular, it can be seen that the plating cell 21 can be moved firstly in a vertical plane, and secondly in a horizontal plane. The plating cell can be moved in the vertical sense, so that it can be moved up
25 and down relative to the conveyor arrangement between an upper and operational position and a lower and inoperational position in order to make sure that the

articles to be coated 26 are in contact with the electrolyte in the plating cell. Secondly the plating cell 21 is moved in a horizontal plane, such that when the plating cell is in the lower position, it can be removed
5 out from underneath the conveyor arrangement to a position (see dotted outline in Figure 2) adjacent the conveyor arrangement where an operator can then access the plating cell for maintenance purposes. In this regard, a support mechanism 30 is provided for the plating cell, and
10 furthermore, hydraulic cylinders (not shown) are provided to move the support mechanism 30 and plating cell 21 in the vertical plane. For movement in the horizontal plane, the plating cell can be manually moved by gripping handles 32 on the side of the plating cell. A supply tank 29 is also
15 provided to replace or "top up" the electrolyte in the cell when necessary. A protective cover 33 can also be provided over the support arrangements 18 and 20.

In order to pass current to the articles 26 which is acting as an anode in the electrolysis process, brushes
20 (not shown) are provided above the electrolyte tank (see 13) to contact the support members and thereby conduct current through to the articles 26.

Referring to Figure 4, an apparatus 34 for loading the article to be coated to the support structure
25 is shown. In particular, a stack of articles 36 to be coated is shown which are then vacuum sucked (see 38) to a wheel inserter section 40 which then move the articles into

a feed conveyor 41 having a number of slotted feed sections 42. Thereafter, hydraulic cylinders 44 are shown which act to push up the articles to be coated from the slotted feed sections into the fingers of the support structure which are synchronized to open at the same time to accept the articles. Thereafter the fingers are closed after a short time to securely hold the articles for subsequent transportation by the conveyor.

In Figure 5, an unloading apparatus 46 for the articles now coated is shown where the fingers are synchronized to open and release the articles and drop these into receiving slots 48 on a receiving conveyor 50, whereafter these articles are dropped by gravity at the end of the receiving conveyor onto stacking runners 52 which thereafter drop the articles into a stack (see 54).

In such an apparatus, due to the vertical orientation of the conveyor, a number of article support structures can be provided closely side by side, which means that a machine has increased capacity over similar prior art machines. Furthermore, since each support structure is split into a plurality of individual support members (which incidentally only a few of which are shown drawn in Figure 1 for simplicity), it is much easier to repair such when they are damaged since the whole support structure does not have to be repaired. Finally, the fingers are such that no shear forces are transferred to

the article being coated, which leads to much less damage thereto.

Such a machine is particularly useful for plating IC strips, so that they can thereafter be soldered. The arrangement, however, could be used for any type of article required to be electroplated.

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CLAIMS:

1. An electroplating apparatus comprising a conveyor arrangement to support articles for plating, and a series of
5 electroplating treatment vessels adjacent to the conveyor arrangement, the conveyor arrangement being mounted and rotated about substantially horizontal axes, such that the conveyor arrangement moves in a substantially vertical plane, wherein the conveyor arrangement comprises at least one support structure made up of
10 plurality of support members, each of which support members holds a plurality of article contact members which are used to grip and secure the articles for plating, and wherein at least one of the contact members has a portion which overlaps with the corresponding portion of adjacent contact members such that any article being plated and
15 supported by the contact members is held between the overlapping portions of the contact member(s), the contact member(s) being movable between two positions, a first position where the contact member(s) is open and its overlapping portion not in engagement with either the articles to be plated or adjacent contact members, and
20 a second position where the contact member(s) is in a closed position and its overlapping portion in contact either with the article to be plated or adjacent contact members.

2. An apparatus as claimed in Claim 1 wherein the conveyor arrangement comprises a plurality of support structures,



each of said support structures being made up of a plurality of support members.

3. An apparatus as claimed in either Claim 1 or 2 wherein the support members are removable.

5 4. An apparatus as claimed in any preceding claim wherein the conveyor arrangement comprises at least two series of support structures.

5. An apparatus as claimed in any preceding claim which has a loading section, which section includes means to vacuum suck
10 a plurality of articles to be plated one at a time from a stack onto an inserting machine.

6. An apparatus as claimed in Claim 5 wherein the articles are inserted by the inserting mechanism into a feeding mechanism.

15 7. An apparatus as claimed in Claim 6 wherein the articles are pushed up from within the feeding mechanism up into contact with the overlapping portions of the contact members, the contact members being synchronized to open and close at the appropriate time.

20 8. An apparatus as claimed in any preceding claim which is also provided with an unloading section, which section receives plated articles dropped down from the support members.

9. An apparatus as claimed in Claim 8 wherein means are provided to place the articles into stacks.



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10. An apparatus as claimed in any preceding claim wherein some of the contact members are movable in one direction, whilst the rest of the contact members are movable in the opposite direction.

5 11. An apparatus as claimed in Claim 10 where all the contact members movable in one direction are mounted on one component, and wherein all the other contact members movable in the other direction are mounted on another component, the two components being joined together to form a support member.

10 12. An apparatus as claimed in any preceding claim wherein the contact members are arranged to be movable in a direction which is opposite to the direction the adjacent contact members move.

13. An apparatus as claimed in any preceding claim
15 wherein the overlapping portions of the contact members overlap each other in a substantially vertical plane.

14. An apparatus as claimed in any preceding claim wherein the contact members are arranged side by side, and are orientated to intersect each other in a substantially vertical plane.

20 15. An apparatus as claimed in any preceding claim wherein the overlapping portion of the contact member(s) is situated at the outer end of the contact member(s).

16. An electroplating apparatus substantially wherein described with reference to the accompanying drawings.
