

DESCRIPTION

DEVICE FOR RECEIVING OR HOLDING SEVERAL SUBSTRATES AND GALVANIZING DEVICE

FIELD OF APPLICATION AND PRIOR ART

[001] The invention relates to a device for receiving or holding several flat substrates in one plane, as well as a galvanizing or electroplating device with a passage path for the substrates through a treatment chamber, the substrates being held in an aforementioned device.

[002] Hitherto substrates have been conveyed on conveying rollers lying in the manner of a roller conveyor in galvanizing devices for substrates, such as e.g. printed circuit boards or more especially solar cells or wafers. However, this can give rise to problems in the case of very sensitive substrates, such as e.g. thin solar cells. Here the substrates can be formed from very thin silicon, which is correspondingly sensitive or fragile. In addition, sensitive substrates have to be handled with extreme care, e.g. on introduction into a galvanizing device. In many cases this means either increased mechanical expenditure for the gripping devices or a decelerated handling, which gives rise to undesired delays.

PROBLEM AND SOLUTION

[003] The problem of the invention is to provide an aforementioned device for receiving or holding several flat substrates, as well as a galvanizing device suitable for the working thereof, enabling the problems of the prior art to be avoided and permitting a more careful working and conveying of the substrates.

[004] This problem is solved by a device having the features of claim 1 and a galvanizing device having the features of claim 13. Advantageous and preferred developments of the invention form the subject matter of the further

claims and are explained in greater detail hereinafter. By express reference the wording of the claims is made into part of the content of the description.

[005] According to the invention the device has a frame with frame pieces forming reception zones between them and as a result of the frame pieces recesses or cutouts are formed. The frame pieces can e.g. run in grid-like manner, particularly with an outer frame and intermediate frame pieces as subdivisions. The frame pieces have supports for the substrates on which the substrates rest. Thus, the mechanical holding of the substrates and/or an electrical contacting takes place on the substrate side engaging on the supports. In this way a reception device or holder for several flat substrates can be created, in which the substrates are placed in the reception zones. For various treatment steps with respect to the substrates, as well as for conveying and in certain circumstances also storage, there is no need to move the individual substrates and instead the complete reception device is moved. The latter can be made more robust than the substrates, so that it is readily possible to use conventional gripping devices or the like. As a result of the supports there can be a precisely defined connection between the reception device and the substrate, which can be matched to specific substrate characteristics. As a result of the reception device it is possible in the case of a plurality of substrates to not only move one substrate in connection with individual working steps, but instead all the substrates of a reception device can be moved. If electrical contacting with the substrates takes place via the reception device or the supports, in certain cases it is possible to economize additional contacting devices directly on the substrates. This also has the advantage that the mechanical loading of the substrates by contact rollers or other contacting devices can be reduced or avoided. Thus, advantageously the reception device brings about both a mechanical holding or reception of the substrates and also an electrical contacting thereon.

[006] The supports can e.g. be constructed as projections, which project or emanate from the frame pieces. The projections can either be relatively narrow, i.e. almost punctiform, in order to bring about a very limited surface coverage on the substrates. This permits a contact with a treatment medium in a

galvanizing device in an advantageous, very large-area manner. Alternatively the projections can be wider in order to bring about a type of linear supporting of the substrates with their marginal area on the receptacles or frame pieces. This permits an adequately stable supporting or bearing action, especially with sensitive substrates, because there is a distribution thereof. The projections can also run below the plane of the frame pieces, e.g. by a downward bend. This makes it possible to have the bearing substrates in roughly one plane with the holder or the frame pieces. It is also possible for the projections to project downwards over the plane formed by the underside of the frame pieces. Advantageously the substrates rest in the reception device or on the projections in such a way that their top side is not below the plane of the top side of the frame pieces and instead preferably projects by a small amount. This makes it possible to ensure that rollers or the like engaging from above in all cases also engage on the top side of the substrates and not mainly on the frame pieces projecting over the substrates.

[007] For electrical contacting purposes it is possible to provide on the supports special contacts which project upwards. Through said contacts, which are in particular fitted separately to the projections, electrical contacting can be improved independently of the material or construction of the projections. Contacts can be in the form of contact projections, contact points or contact studs with electrically conductive surfaces. In particular, the contacts can be made from contact material advantageously used for switching contacts. In a development of the invention it is possible to provide them with seals in such a way that no electrical contact takes place when the substrates are applied. Thus, in the case of a galvanizing process undesired deposits on the contacts can be avoided, because the treatment medium cannot come into direct engagement with the contacts as a result of the seal. It is e.g. possible to have cup or pot-shaped rubber seals around the contacts.

[008] It is advantageous for electrical contacting if some or all the frame pieces are electrically conductive. In particular the entire reception device is electrically conductive and can e.g. be made from metal. Advantageously all parts or frame pieces of the reception device are electrically conductively in-

terconnected. For this purpose such a receptacle can be rough worked from a metal sheet in the manner of a grid-like tray.

[009] In a further development of the invention, it is possible to provide the reception device with an electrically insulating coating, e.g. paint or a covering. This avoids any deposition of coating material on the receptacle during a galvanizing process. If such deposition of coating material e.g. takes place on the aforementioned contacts as exposed surfaces of the reception device, then at certain time intervals said contacts must be cleaned or stripped free, as is known to the expert.

[010] A part or section of the device can project on an outside, particularly an outer area or from an outside frame piece. This is advantageously bent upwards from the plane of the substantially flat device, particularly with a further sideways bending following onto the same. If said projecting section is e.g. electrically conductively connected to the frame pieces or electrical contacts for the engagement of the substrates, then via said section there can be an electrical contacting with the reception device. For this purpose, e.g. the section can be made from the same material as the remainder of the device, e.g. it can be rough worked from the aforementioned metal sheet. It is advantageously possible to construct the entire reception device integrally or in one piece. Said section can also be used for the gripping of the reception device in an area which is remote from the inserted substrates, so as to provide protection for the same.

[011] In a further development of the invention it is possible to construct the reception device in such a way that a substrate is sealingly located in a reception zone between adjacent frame pieces. Thus, all the reception zones of a reception device carry substrates and in this way form a substantially liquid-tight surface. The sealing or tightness requirements must at least be such that in the case of movement through the treatment medium or a liquid bath liquid does not penetrate from below through the areas between the substrate and the frame pieces, this applying in the case where the pressure of the liquid from below is only limited. For this purpose it is e.g. possible to have

seals along the frame pieces or along the areas where the substrate sides are close to the frame pieces. This makes it possible to keep the top side of the substrates and also the reception device free from treatment liquid. This is especially advantageous if there is to be a treatment or coating only on the downwardly directed side of the substrates.

[012] Advantageously the reception device is constructed for identical substrates and each substrate is then held in the same way. To this end several reception zones are provided successively in juxtaposed manner, e.g. with an overall rectangular zone.

[013] In a further development of the invention onto the reception device can be fixed a covering device or cover, particularly in a movable or articulated manner. Substrates placed in the reception device can be fixed by the cover or secured against dropping out or becoming detached. The cover can cover roughly the same surface area as the reception device. Advantageously it has a similar structure with pieces and interposed zones. Particularly advantageously it is constructed in a substantially similar or almost identical manner to the reception device. If the substrates are also held or secured from above in the reception device, easier movement thereof is possible and in particular can be held vertically or even rotated. If the cover is fixed at a number of points to the reception device, it can be made much thinner or weaker, because it does not necessarily have to form an independently supporting structure. Its function is solely to hold the substrates in the reception zones of the reception device.

[014] For the inventive galvanizing device it can be provided that the substrates run through the treatment chamber. The latter contains a treatment medium, e.g. an electrolyte, for the galvanic application of a coating to the substrates. The substrates can advantageously be thin printed circuit boards or alternatively thin solar cells, as described hereinbefore. The passage path has conveying means, e.g. conveying rollers, wheels, etc. By means of the latter the above-described reception device is conveyed or runs on the passage path through the treatment chamber. On the reception devices or on

the substrates can engage pressure rollers, wheels or the like for various different functions. It is possible for there to be at least one such pressure roller in the passage direction for each successive row of substrates. If the substrates are very sensitive, as stated hereinbefore, the pressure rollers are advantageously particularly soft so as not to damage the substrates.

[015] An aforementioned reception device projects laterally over or away from the substrate plane and is in particular bent upwards. The angular section extends to an aforementioned electric contacting means and is advantageously not in contact with the treatment medium or is positioned outside the galvanizing device. It is particularly advantageous to bend the reception device upwards and then to the side, so that the end projects over the galvanizing device. Electrical contacting can take place through engaging contacting rollers or jointly running contact clips or other contacts, such as also contact brushes.

[016] Advantageously the treatment medium extends to the underside of the substrates passing through or up to the latter. In order to keep the top of the substrates dry and clean, it is possible for the height level to extend relatively precisely to the underside of the substrates. This can lead to a type of wave formation in the treatment medium, in order that the underside of the substrates is reached by the weak waves or with their wave crests. Alternatively substrates can be sealingly placed in the reception device, as described hereinbefore.

[017] Electrodes or the like for the galvanizing process can be provided below the substrates. If the substrates pass in fully immersed manner through the treatment medium, electrodes can also be provided above the same.

[018] In another embodiment of the invention on the top side of the reception device, e.g. between the pressure rollers, several contacting means can be provided forming an electrical contact with the substrates. They can be constructed as circumferential contacting rollers. For this purpose they can e.g. engage on the frame pieces, advantageously running in the conveying direc-

tion. It is particularly advantageous to provide at least one contacting means on each frame piece running in the conveying direction.

[019] These frame pieces, on which the contacting means engage, can be advantageously higher than the substrates in the reception device. Thus, they are generally above the liquid bath level. They are also electrically conductive. For contacting the substrates, besides an aforementioned, completely conductive frame, contact bridges can be provided, which run from the frame pieces with the contacting means to the substrates located therein. They can have a bow or bridge-like construction and lead bilaterally from the frame pieces to the substrates and e.g. the substrates can rest on ends of the contact bridges. This permits electrical contacting of the substrates even without conductive frames.

[020] Between in each case one pair of pressure rollers can be provided a contacting roller, preferably on the same shaft. The contacting means, preferably contacting rollers, can be constructed resiliently or elastically, particularly with contacting surfaces projecting resiliently from a solid central part. They can be segmented, but this generally only serves to provide a more resilient construction.

[021] These and further features can be gathered from the claims, description and drawings and the individual features, both singly or in the form of subcombinations, can be implemented in an embodiment of the invention and in other fields and can represent advantageous, independently protectable constructions for which protection is claimed here. The subdivision of the application into individual sections and the subheadings in no way restrict the general validity of the statements made thereunder.

BRIEF DESCRIPTION OF THE DRAWINGS

[022] An embodiment of the invention is described in greater detail hereinafter relative to the attached diagrammatic drawings, wherein show:

- Fig. 1 A sloping view of an inventive reception device.
- Figs. 2 & 3 Larger scale detail views of the reception device of fig. 1.
- Fig. 4 A sectional representation through an inventive galvanizing device for solar cells.
- Fig. 5 A side view of the galvanizing device of fig. 4.
- Fig. 6 A sloping view of another inventive galvanizing device.
- Fig. 7 A larger scale detail view of the contacting on the reception device of fig. 6.

DETAILED DESCRIPTION OF THE EMBODIMENT

[023] Fig. 1 shows in a sloping or oblique view a reception device 11, which is constructed in the manner of a tray. Outside external frame pieces 12 and intermediate inside frame pieces 14 form a type of grid or lattice with recesses between them, so as to constitute reception zones 20. It can be seen that all the reception zones 20 between frame pieces 12 and 14 are of the same size, although this need not be the case.

[024] On the rightwards-directed side is provided an angular section 16. Here the outside frame piece 12 is firstly bent upwards and then with a marginal strip 17 to the side again. The reception device 11 can be made from metal, particularly a sheet metal plate. It can be coated in insulating manner with a covering or a paint, which is resistant to the treatment media generally used during galvanizing. The marginal strip 17 is free on at least one side or has an electrically conductive surface, advantageously this is on both sides.

[025] Particularly the larger scale view of figs. 2 and 3 reveals how at a number of points projections 22 project from the frame pieces 12 and 14. They can either be fixed subsequently to the frame pieces, e.g. by welding, or al-

ternatively they can be rough worked by a punching process or the like from a single metal sheet together with said frame pieces. The sectional view of fig. 3 shows that the thickness of the projections 22 is less than the thickness of the frame pieces and in particular they are only half as thick. As a result in the case of the solar cells or silicon wafers 26 resting on contacts 24 located at the end of projections 22, as shown in broken line form in fig. 2, the top side of the solar cells is not too far above the top side of the reception device 11 or frame pieces 12 and 14. This is explained in greater detail hereinafter relative to figs. 4 and 5.

[026] The contacts 24 can e.g. be contact points or tips and can be made from a contact material normally used for switching contacts or the like, i.e. from a different material to the projections 22. This has the advantage of even better contacting with the solar cells 26 or other substrates to be placed in the reception zones 20.

[027] In alternative developments of the invention, in place of the individual, relatively small projections 22, wide strips project from the frame pieces 12 and 14 permitting a wider engagement of the solar cells and consequently a better mechanical support. It is also possible to have more than the three projections 22 shown for each reception zone 20 and they are in particular distributed over all the frame pieces. The advantage of a small number of projections 22 is the ease of manufacture. In addition, as a result the treatment medium is applied particularly well to the underside of the substrates or solar cells.

[028] In a further development of the invention it is conceivable to have circular seals or the like around the contacts 24 at projections 22 in such a way that the contacts 24 engage on the solar cells 26 in a substantially punctiform area. This engagement area is surrounded by the seal and shielded to the outside, the seal being as close as possible to the contacts in order to keep the engagement area as small as possible. In this case the contacts are protected from coming into contact with the treatment medium and are in this

way not coated. The precise construction of such seals is known to the expert and can be implemented without difficulty.

[029] In the representation of a galvanizing device 30 in fig. 4, walls 31 form a treatment chamber 32 housing an electrolyte as a treatment medium in which is dissolved the metal which is to be deposited on the solar cells 26. The reception devices 11 according to fig. 1 are conveyed lying on conveying rollers 33 through the galvanizing device 30. The conveying rollers 33 are driven by a drive 34. As can be seen in fig. 5 and as is generally known, numerous conveying rollers 33 are successively arranged and form a passage path for the reception devices 11 or solar cells 26.

[030] At each reception zone 20 the reception device 11 is covered by a solar cell 26. The pressure rollers 36 engage on the top side of solar cells 26 in galvanizing device 30. They comprise a very flexible rubber covering 37 on a metal core 38 and are also driven by drive 34. The pressure rollers 36 are positioned in such a way that they in each case rest relatively precisely centrally along the rows of successive solar cells 26. The function of the pressure rollers 36 is to hold the solar cells 26 in the reception device 11 or reception zones 20 and to ensure the engagement of the contacts 24 on the underside.

[031] The angular section 26 of reception device 11 projects upwards at least over the level of the treatment medium in the treatment chamber 32. The rightwards-projecting marginal strip 17 projects over the right-hand wall 31 and beyond. A contact roller 42 contacts the underside. In much the same way as for the conveying rollers 33 and pressure rollers 36 in fig. 5 a plurality of contact rollers 42 is provided along the passage path. By means thereof there is a constant electrical contact with the marginal strip 17 and consequently the reception device 11. The contact roller 42 is once again connected to a power source 44 or its negative pole. The positive pole of the power source 44 is connected to elongated electrodes 40, which are positioned between the rollers above and below solar cells 26 in treatment chamber 32.

FUNCTION

[032] The solar cells 26 are placed in the reception device 11 for treatment purposes. Electrical contacting of the solar cells with the reception device 11 takes place via the contacts 25 engaging with the underside. By means of a not shown covering device or the like the solar cells 26 can be firmly held in the reception zones 20, e.g. by a further, grid-like frame, clips, etc. In a further development of the invention springs or the like can be provided which press the solar cells 26 into the reception zones 20 or against the contacts 24 and are automatically locked on inserting the substrates. Finally, it would also be possible to have small suction cups, a vacuum holding means, etc., e.g. in the vicinity of projections 22. They can also embrace the contacts 24 with the aforementioned sealing function.

[033] The solar cells 26 are advantageously made from silicon or are silicon wafers. Hitherto they have been printed on in complicated manner in part with silver paste as the contact material. The galvanizing device 30 is provided to galvanically deposit the contact layer, particularly on the front of the solar cells. Thus, the treatment medium in the treatment chamber 32 contains a corresponding proportion of contact material, e.g. silver.

[034] The reception device 11 containing the solar cells 26 is then introduced into the galvanizing device 30. The reception device 11 moves along the passage path on conveying rollers 33 through said treatment chamber 32. If deposition of silver is only to take place on the underside of the solar cells 26, the height of the treatment medium can be correspondingly chosen or the treatment medium should only extend to the underside of the solar cells 26.

[035] The solar cells 26 are electrically conductively connected by their underside via contacts 24 and projections 22, as well as frame pieces 12 and 14 with the angular section 16 or marginal strip 17. As contact rollers 42 extend up to the marginal strip 17 and are once again connected to the negative pole of power source 44, the undersides of the solar cells 26 are at this potential.

By means of electrodes 40 connected to the positive pole of power source 44, voltage is applied or the potential gradient to the solar cells 26 is built up for the deposition of silver from the treatment medium on the underside of solar cells 26. Process parameters, such as the passage speed and composition of the treatment medium and the operation of the power source 44, are in each case to be chosen as a function of the given application and provide no problem to the expert. Following adequate silver deposition or coating, the reception device 11 with solar cells 26 is removed or extended out of the galvanizing device 30. This can be followed by a further treatment or an intermediate storage. For as long as the solar cells 26 are not individually required or worked, they can be left in the reception device 11. In the latter they can be easily conveyed, stored and protected against damage.

[036] As coating material is also deposited on the reception devices 11, at least on contacts 24 if they are unprotected, the coating is to be removed therefrom at certain time intervals. This process is called "destripping" by the experts. It is advantageous if the reception device 11 only has an electrically conductive surface in the vicinity of contacts 24 and marginal strip 17, because then no coating can take place in the remaining areas. Alternatively to the aforementioned removal of a coating, this can take place in a wet chemical manner.

[037] Fig. 4 shows how the pressure rollers 36 in each case press the solar cells 26 into the reception zones 20. As the top of the solar cells 26 project slightly over the top of the frame pieces 12, 14, it is ensured that the pressure rollers 36 always engage on the substrates or solar cells 26 and consequently press the latter downwards against the contacts 24.

[038] In addition to the power source 44, there can also be light sources below the solar cells 26. They can assist the coating process by irradiating the solar cells 26 from below with light of a suitable wavelength, preferably in a range 400 to 1100 nm. In certain circumstances it is even conceivable for the necessary galvanizing current to be produced solely by the light sources.

However, advantageously such a light-induced current generation is combined with an aforementioned, controlled power source.

[039] In the alternative variant according to figs. 6 and 7, a frame-like reception device 111 with outside frame pieces 112 and inside frame pieces 114 is covered with substrates 126. They are conveyed by conveying rollers 133 through a plant similar to that described hereinbefore. Substrates 126 are held by pressure rollers 136 in the reception device 111. The pressure rollers 136 are located on the same shafts 150 as the intermediately provided contacting rollers 152. The latter have resilient contact zones 154 projecting from a central part 153. The contacting rollers 152 or contact zones 154 engage on the top of the frame pieces 114. The latter are continuously electrically conductive or have a corresponding coating or support.

[040] From said electrically conductive frame pieces 114 contact bridges 155 project bilaterally. They can alternatively be in the form of clips or have some similarly functioning shape. The contact bridges 155 pass into ends 156 on which rest the substrates 126 and are in this way electrically contacted in the aforementioned manner with the contacts 24.

[041] It is advantageous here that an electrical contacting on the frame takes place in surface-distributed, central manner, i.e. not only from one side. Thus, there are no current gradients. In the case of local contamination on one contact surface, there is much less risk of an interruption of the power supply. The individual current supply to all the frame pieces 114 in the passage direction is also conceivable, if further measures of galvanic separation or isolation from electrolysis are carried out.

CLAIMS

1. Device (11) for receiving or holding several flat substrates (26) in one plane, having a frame with frame pieces (12, 14), which form between them reception zones (20) with recesses (20) or cutouts in the vicinity of the frame pieces or between them, the frame pieces (12, 14) having supports (22, 24) for the substrates (26) for mechanically holding the same and/or for electrical contacting (24) on the engaging substrate side.
2. Reception device according to claim 1, characterized in that the supports are projections (22) projecting from the frame pieces (12, 14), the projections (22) more particularly running below the plane of the frame pieces in such a way that the substrates (26) rest thereon and are roughly in one plane with the receptacle or with the frame pieces (12, 14).
3. Reception device according to claim 1 or 2, characterized in that the supports (22) have upwardly projecting contacts (24), particularly contact projections or contact points.
4. Reception device according to one of the preceding claims, characterized in that at least part of the frame pieces (12, 14) and in particular all the frame pieces or the reception device (11) are electrically conductive and are preferably made from metal and where in particular electrically conductive frame pieces (12, 14) are electrically conductively interconnected.
5. Reception device according to claim 4, characterized in that it and in particular its frame pieces (12, 14), are largely electrically insulated on their surface, preferably by a coating.
6. Reception device according to one of the preceding claims, characterized by a section (16, 17) projecting from the outer area thereof, particularly from an outside frame piece (12) and preferably the section is bent upwards (16)

from the plane of the reception device (11) and in particular upwards and then to the side (17).

7. Reception device according to claim 6, characterized in that the projecting section (16, 17) is electrically conductively connected to the frame pieces (12, 14) and/or the electrical contacting means (24) on the engaging substrates (26) and in particular it has an electrically conductive surface.

8. Reception device according to one of the preceding claims, characterized in that it is integrally constructed, preferably in one piece.

9. Reception device according to one of the preceding claims, characterized in that a substrate (26) rests in sealing manner in a reception zone (20) between adjacent frame pieces (12, 14) in such a way that it downwardly seals or closes against the penetration of liquid at low pressure between the frame pieces.

10. Reception device according to claim 9, characterized by seals in the vicinity of the frame pieces (12, 14) for engagement on the inserted substrate (26).

11. Reception device according to one of the preceding claims, characterized in that there are several reception zones (20) in juxtaposed, successive manner and preferably of the same size.

12. Reception device according to one of the preceding claims, characterized by a covering device which can be fixed to the reception device (11), inserted substrates (26) being located between the reception device (11) and the covering device and are secured against dropping out and in particular the covering device roughly covers the same surface area as the reception device (11).

13. Galvanizing device with a passage path for the substrates (26) through a treatment chamber (32), which has a treatment medium such as an electrolyte for the galvanic application of a coating to the substrates (26), characterized in that the passage path has conveying means such as conveying rollers

(33) or the like for the horizontal conveying through of a reception device (11) according to one of the preceding claims.

14. Galvanizing device according to claim 13, characterized by pressure rollers (36) engaging from above on the reception devices (11) or substrates (26) and there is at least one pressure roller (36) for each successive row of substrates (26) in the passage direction and in particular the pressure rollers have a very flexible or soft construction.

15. Galvanizing device according to claim 13 or 14, characterized in that the reception device (11) according to one of the claims 1 to 12 projects upwards with a lateral angular section (16, 17) away from the plane of substrates (26) and extends to an electrical contacting means (42), preferably with a further intermediate horizontal bend and in particular the electrical contacting means has engaging contact rollers.

16. Galvanizing device according to one of the claims 13 to 15, characterized in that the height level of the treatment medium extends just up to the underside of the substrates (26) located in reception device (11).

17. Galvanizing device according to claim 13 or 14, characterized in that there are several contacting means on the top of the reception device (11), particularly between the pressure rollers (36) and they are preferably in the form of circumferential contacting rollers, the contacting means having an electrical contact with the substrates (26).

18. Galvanizing device according to claim 17, characterized in that the contacting means engage on frame pieces (12, 14) running in the conveying direction and preferably at least one contacting means engages on each frame piece running in the conveying direction and in particular said frame pieces are higher than the level of the substrates (26) in reception device (11).

19. Galvanizing device according to claim 18, characterized in that electric contact bridges run from the frame pieces on which the contacting means en-

gage up to the substrates (26) located therein and preferably bilaterally and in bow-like manner away from the frame pieces to the substrates and in particular the substrates rest on ends of the contact bridges.

20. Galvanizing device according to one of the claims 17 to 19, characterized in that a contacting roller is provided between each pair of pressure rollers (36), preferably on the same shaft.

21. Galvanizing device according to one of the claims 17 to 20, characterized in that the contacting means, preferably contacting rollers, have a resilient or elastic construction, particularly with contacting surfaces projecting resiliently from a solid central part.