

APPARATUS AND METHOD FOR STRIP SOLDER PLATING

The present invention relates to a method and apparatus for strip solder plating and, more
5 particularly, to a method and apparatus for performing the solder plating of mold strips
using a circular rotating strip carrier.

It is known in the semiconductor manufacturing industries, the solder plating machine, as
part of the process line, normally exceeds 20 metres in length. This is due to the fact that
10 the system is using a conveyor to carry the mold strips through a linear process line and
consequently consumes a large amount of floor space and is cumbersome to add on to
existing front-end processes.

It would therefore be advantageous to reduce the size of the solder plating machine so that
15 it would take up less floor space and be more compact and manageable to install. These
advantages are achieved in embodiments of the present invention by arranging the process
stations in a circular fashion.

The present invention provides an apparatus for solder plating at least one work piece, the
20 apparatus including:

- a frame;

- a carrier mounted on the frame for rotation about a generally vertical axis and
having a plurality of work piece holders;

- a plurality of process stations arranged in a circular array, at least some of said
25 process stations including electrolytic solutions;

- said work piece holders each having top and bottom fingers for holding respective
work pieces;

- indexing means for moving the carrier so that work pieces held thereon are moved
to successive process stations, the indexing means being operable to move the carrier
30 between raised and lowered positions as it moves the work pieces to successive stations;

- a plurality of first contacts which are fixed in position relative to the process

stations; and

a plurality of second contacts which are fixed in position relative to the carrier; and
wherein the indexing means is operable to cause selected first and second contacts
to engage one another when the carrier is in said lowered position to thereby enable
5 electrical connections to be established with the process stations which include said
electrolytic solutions.

The present invention further provides a method for solder plating at least one work piece,
including the steps of:

loading said at least one work piece into a respective one of a plurality of work
10 piece holders, said work piece holders being located on a carrier and having a plurality of
top and bottom fingers for holding respective ones of said at least one work piece, said
carrier having raised and lowered positions and being rotatable about a vertical axis;

rotating said carrier in a circular path so that said work piece holders are suspended
on said carrier over a plurality of process stations arranged below said work piece holders
15 in said circular path, at least some of the process stations including a plurality of
electrolytic solutions;

moving said carrier to said lowered position to cause engagement of first contacts,
which are fixed in position relative to the process stations, with selected second contacts,
which are movable with the carrier, to thereby enable electrical connections to be
20 established with the process stations which include said electrolytic solutions.

The accompanying drawings illustrate embodiments of the invention and serve to
explain the principles of the invention. It is to be understood, however, that the drawings
are designed for the purposes of illustration only, and not as a definition of the limits of
25 the invention.

Figure 1 is a plan view of a solder plating apparatus in accordance with an
embodiment of the present invention.

Figure 2 is a front view of the apparatus shown in Figure 1.

Figure 3A is a fragmentary perspective view of part of the apparatus showing a
30 mold strip holder attached to the carrier.

Figure 3B is a fragmentary perspective view of part of the apparatus showing a

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mold strip holder in a position to be lowered into a process station.

Figure 4 is a perspective view showing a mold strip held by the strip holder.

Figure 5A is a side view of the loading arm and strip holder.

Figures 5B, 5C, 5D, 5E, 5F and 5G show the operation of the loading arm when
5 loading a mold strip into the strip holder.

Figure 6A is a side view of the unloading arm and strip holder.

Figures 6B, 6C, 6D, 6E, 6F and 6G show the operation of the unloading arm when
unloading a mold strip from the strip holder.

Figure 7 is an end view of a descale tank used in an embodiment of the apparatus
10 shown in Figure 1.

Figure 8A is a plan view of the descale station.

Figure 8B is a side view of the descale station.

Figure 9 is an end view of a water rinsing station used in an embodiment of the
apparatus shown in Figure 1.

15 Figure 10A is a plan view of the water rinsing station.

Figure 10B is a side view of the water rinsing station.

Figure 11 is an end view of an activation station used in an embodiment of the
apparatus shown in Figure 1.

Figure 12A is a plan view of the activation station.

20 Figure 12B is a side view of the activation station.

Figure 13 is an end view applicable to the pre-dip, neutralizing and stripping
stations used in the apparatus shown in Figure 1.

Figure 14A is a plan view of the pre-dip station.

Figure 14B is a side view of the pre-dip station.

25 Figure 15A is a plan view of the neutralizing station.

Figure 15B is a side view of the neutralizing station.

Figure 16A is a plan view of the stripping station.

Figure 16B is a side view of the stripping station.

Figure 17A is an end view of four plating stations, grouped together, as used in an
30 embodiment of the apparatus shown in Figure 1.

Figure 17B is an end view of a plating station used in an embodiment of the

apparatus shown in Figure 1.

Figure 18A is a plan view of the four plating stations.

Figure 18B is a sectional view taken along the line X-X of Figure 18A.

Figure 19A is an end view of an air blow station used in an embodiment of the
5 apparatus shown in Figure 1.

Figure 19B is a plan view of the air blow station.

Figure 20A is an end view of a drying station used in an embodiment of the
apparatus shown in Figure 1.

Figure 20B is a plan view of the drying station.

10 Figure 21 is a schematic representation of an electric circuit made when the carrier,
in accordance with an embodiment of the present invention, is in a lowered position and a
strip holder is immersed in an electrolytic solution.

Embodiments of the present invention are described below in greater detail, and by way of
15 example only, with reference to the accompanying drawings, wherein like components are
identified by like numerals.

Figure 1 shows a solder plating machine 1 of the invention which includes a bank 11 of
process stations which are arranged in a circular path. The machine 1 includes a carrier 10
20 which carries a mold strip 6 such as an encapsulated electronics components and like
devices through the various process stations. The process stations include a loading station
101, followed by chemical treatment, drying and unloading stations, arranged at equal
intervals around the circular path and finishing with the water rinsing station 120. The
chemical treatment stations include the descale stations 102 and 103, water rinsing stations
25 104, 106, 112, 114, 115 and 120, activation station 105, pre-dip station 107, plating
stations 108 to 111, neutralizing station 113 and the stripping station 119. The apparatus
also includes the air blow station 116, drying station 117 and unloading station 118.

In the arrangement shown Figure 2, the carrier 10 is mounted on a connecting shaft 14,
30 which is driven by a rotary indexer 15. The carrier 10 is raised and lowered by the air
cylinder 13. Figure 2 shows, at the top right hand side, the carrier 10 in a raised position,

and at the top left hand side, the carrier 10 in a lowered position. The rotary indexer 15 rotates around an axis 30 by a fixed amount as part of each step in the process. In the example described herein, the rotary indexer 15 rotates by 18 degrees in each step. The air cylinder 13 serves to raise and lower the carrier 10 and therefore raise and lower mold strip holders 20 which are attached to the carrier 10 and the mold strips 6 which are held by the holders 20 are sequentially moved into and out of the chemical treatment and air drying stations.

The solder plating machine 1 has a frame 3 which has an upper part 2 and a lower part 4. The lower part 4 houses the air cylinder 13, the rotary indexer 15, a flowmeter 16 for measuring the water flow rate of the water supply to rinsing station, a pump 12 for providing the chemical circulation, a waste treatment tank and a number of valves 17 to regulate water flow in the solder plating machine 1. A total of seven chemical pumps are provided in the solder plating machine 1. The upper part 2 houses the carrier 10 and the chemical treatment and air dryer stations and allows access for the loading and unloading of the strips 6 into and out of the mold strip holders 20. The upper part 2 of the solder plating machine 1 may be made partially transparent to facilitate viewing of the process by an operator and may be fully enclosed for clean and safe environment.

The carrier 10 has a number of strip holders 20 attached thereto by an arm 24, as shown in Figures 3A, 3B and 4. Attached to the arm 24 is a contact bar 23, which is electrically connected to upper finger spring contacts 32, but a stainless steel bracket 34 and contact bar 23 are electrically isolated from the arm 24, at least in part, by an insulation bar 33. Each of the mold strip holders 20 holds the mold strip 6 so that the longer dimension of the mold strip 6 is horizontal and aligned approximately radially with the axis 30 and the thinnest dimension is aligned vertically. Each strip holder 20 includes top fingers 28 which contact the top edge of the mold strip 6 while bottom fingers 27 of each holder 20 contact and hold the mold strip 6 at the lower edge thereof. The top and bottom fingers 27 and 28 are resiliently biased towards each other by the spring contacts 32 and thus grip the mold strip 6 firmly. The mold strip 6 makes electrical contact with the top fingers 28 and may also make electrical contact with the bottom fingers 27, for electrolytic cleaning and

electroplating the mold strips 6 as will be described below. Preferably, there is a total of twenty of the mold strip holders 20 attached to the circular carrier 10, and each is separated from adjacent mold strip holders 20 at an angle of 18 degrees. Each mold strip holder 20 will hold at least one mold strip 6 so that the carrier 10 holds a number of mold
5 strips 6 undergoing various stages of electrolytic cleaning, electroplating and other treatment process steps. Each mold strip holder 20 is preferably constructed of stainless steel so as to be resistant to the chemicals used in the chemical and electrochemical processes. The mold strip 6 can be a printed circuit board or any other work piece or thin frame suitable for undergoing the soldering process.

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In the preferred embodiment, the strip holders 20 advantageously ensure that the mold strip 6 is not dropped during the soldering process. The gripping of the mold strip 6 at both top and bottom edges provides a more secure method of holding the mold strip 6 than gripping it only at the top edge of the strip as known in the prior art.

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Figures 5A to 5G and 6A to 6G show the operation of the loading and unloading of the mold strip 6 to and from the strip holder 20. The loading function is performed using a loader mechanism 49 which includes a loading fork 50 and a loader picking arm 52, as shown in Figure 5A and illustrated in Figures 5B, 5C, 5D, 5E, 5F and 5G. Initially, a
20 lifter 40, which is operated by an air cylinder, for lifting up the top fingers is in a down position and the spring contacts 32 of the mold strip holder 20 are in a relaxed state. In the next step, shown in Figure 5C, the lifter 40 raises the top fingers 28 and compresses the spring contacts 32, thus providing enough space for the mold strip 6 to be inserted between the top and bottom fingers 28 and 27, and the loader picking arm 52 extends so
25 that the mold strip 6 becomes slotted into the loading fork 50. In step 3, the loader pivots about an axis and brings the mold strip 6 toward the mold strip holder 20. In the next step, shown in Figure 5D, the loading fork 50 places the mold strip in position between the top and bottom fingers 28 and 27. In the next step, shown in Figure 5E, as the loading fork 50 retracts (by retracting the loader picking arm 52), the lifter 40 returns to the down position
30 and allows the top fingers 28 drop down freely onto the top edge of the mold strip 6 so that it becomes gripped between the top and bottom fingers 28 and 27. The mold strips 6

may be loaded from a buffer magazine (not shown), if the solder plating machine 1 is being used as a stand-alone machine, or from a conveyor, if the solder plating machine 1 is being used in an auto in-line system. The unloader and unloading steps are shown in Figures 6A to 6G and are similar to the loader and loading function except that the unloading steps are performed in the reverse order to those of the loading process. The loading and unloading takes place with the carrier 10 in the lowered position.

Figure 7 shows the descale station 102 of the bank 11 of process stations. The descale station is used to remove organic compounds, such as fingerprints and airborne contaminants, from the mold strip 6. The bank 11 includes a second descale station 103 which is the same as the station 102. Each descale station is divided into an inner cell 26 and an outer cell 25. A descale solution, such as alkaline, circulates from the outer cell 25 to the inner cell 26 via the suction 77 and discharge 76 lines as shown in Figure 8A. After the loading of the mold strip 6, the carrier 10 moves upward and rotates 18 degrees in a clockwise direction, before moving downward to submerge the mold strip 6 in the first descale station 102. When the carrier 10 is in the lowered position, the contact bar 23 will come into contact with the contact bush 22, and current from a rectifier 98 (shown in Figure 21) will be supplied to the mold strip 6 through the contact bush 22, contact bar 23, spring contacts 32 and top fingers 28. The circuit is completed through the descale solution in the station 102 and a cathode plate 75, which is electrically connected to the rectifier 98. In this way, the electrolytic action serves to remove the organic compounds from the mold strip 6. When the carrier 10 is in the lowered position, the strip holder 20 is partially immersed in the descale solution within the inner cell 26 and holds the mold strip 6 entirely immersed in the descale solution. The solution used in the descale stations 102 and 103 may be any known conductive solution appropriate for removing organic compounds. A level sensor 74 is used to protect the chemical pump 12 and heater 73. If the solution is low, this will be detected by the level sensor 74 and the chemical pump and heater will be cut off automatically by a programmable logic controller (not shown). An exhaust suction pipe 80 is provided to draw away any fumes arising from the chemical solution for treatment or recycling. After the mold strip 6 has undergone sufficient treatment in the descale solution, the carrier 10 will move upward and remove the mold

strip 6 from the descale station. When the carrier moves upward, an air knife 70, having branches located on both sides of the strip holder 20, is activated so as to blow any residual solution from the mold strip 6. This helps to preserve the quantity of solution in the station and prevent the next station from being contaminated with unwanted chemicals.

5 The carrier 10 is then rotated 18 degrees to the second descale station 103 for further treatment. Two descale stations are used to increase the effective removal of the organic compounds.

The structure of the stations 103 to 115 is similar to the station 102 and accordingly the
10 same reference numerals have been used to denote parts which are the same or correspond to one another.

Figures 9, 10A and 10B show the water rinsing station 104, the water rinsing stations 106, 112, 114, 115 and 120 being the same or similar. The function of the water rinsing
15 stations is to clean the mold strip 6 before and after chemical treatment and electroplating. The water rinsing station 104 again includes an inner cell 26 and an outer cell 25. The water is supplied from the bottom of the inner cell 26 and overflows into the outer cell 25 and into a drain 82 to a waste treatment tank (not shown). The reason for supplying the water from the bottom is that it effectively cleans the water and pushes out any residue
20 from the inner cell 26 to the drain 82. When the carrier 10 is in the lowered position, the strip holder 20 is partially immersed in the water within the inner cell 26 and preferably holds the mold strip 6 entirely immersed in the water. After the mold strip 6 has undergone sufficient rinsing in the water, the carrier 10 will move upward and remove the mold strip 6 from the water rinsing station. Each rinsing station includes an air knife 70
25 and when the carrier moves upward, the air knife 70 is activated so as to blow any residual water from the mold strip 6 and strip holder 20. This helps to prevent the chemicals in the next station from being diluted with excess water remaining on the mold strip 6 and the top and bottom fingers 27 and 28.

30 Once the metal surface is free from organic components, the oxides are removed by an activation solution. Figures 11, 12A and 12B show the activation station 105 in more

detail. The station again includes an inner cell 26 and an outer cell 25. The activation solution is pumped by a pump 12 from the outer cell 25 to the inner cell 26 via the suction 77 and discharge 76 lines as shown in Figure 12A. Any excess solution overflows from the inner cell 26 back to the outer cell 25. When the carrier 10 is in the lowered position, the contact bar 23 will come into contact with the contact bush 22, and current from the rectifier 98 (shown in Figure 21) will be supplied to the mold strip 6 through the contact bush 22, contact bar 23, spring contacts 32 and top fingers 28. The circuit is completed through the electrolyte solution to PtTi anode plates 85, which are electrically connected to the rectifier. In this way, the electrolytic action serves to remove the oxides from the mold strip 6. When the carrier 10 is in the lowered position, the mold strip holder 20 is partially immersed in the activation solution within the inner cell 26 and preferably holds the mold strip 6 entirely immersed in the activation solution. The solution used in the activation station 105 may be any known solution appropriate for removing oxides such as iron / nickel / copper oxides. A level sensor 74 is used to protect the chemical pump 12. If the solution is low, this will be detected by the level sensor 74 and the chemical pump will be cut off automatically by a programmable logic controller (not shown). An exhaust suction pipe 80 is provided to draw away any fumes arising from the chemical solution. After the mold strip 6 has undergone sufficient treatment in the activation solution, the carrier 10 will move upward and remove the mold strip 6 from the descale station. When the carrier moves upward, the air knife 70, located on both sides of the strip holder 20, is activated so as to blow any residual solution from the mold strip 6 and the top and bottom fingers 27 and 28 as before. This helps to preserve the quantity of solution in the station and prevent the next station from being contaminated with unwanted chemicals.

Figures 13, 14A and 14B show the pre-dip station 107. The function of the pre-dip station 107 is to "condition" the mold strip 6 before solder plating it. The solution used in this station is preferably a diluted acid of the same type as that used in the plating solution. The station includes an inner cell 26 and an outer cell 25. The activation solution is pumped by a pump 12 from the outer cell 25 to the inner cell 26 via the suction 77 and discharge 76 lines as shown in Figure 14A. Any excess solution overflows from the inner cell 26 back to the outer cell 25. When the carrier 10 is in the lowered position, the mold strip holder

20 is partially immersed in the descale solution within the inner cell 26 and preferably holds the mold strip 6 entirely immersed in the descale solution. A level sensor 74 is used to protect the chemical pump 12. If the solution is low, this will be detected by the level sensor 74 and the chemical pump will be cut off automatically by a programmable logic controller (not shown). An exhaust suction pipe 80 is provided to draw away any fumes arising from the pre-dip solution. After the mold strip 6 has undergone sufficient treatment in the pre-dip solution, the carrier 10 will move upward and remove the mold strip 6 from the pre-dip station. When the carrier moves upward, the air knife 70 is activated so as to blow any residual solution from the mold strip 6 and the strip holder 20.

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The neutralizing and stripping stations 113 and 119, which come after electroplating stations 108 to 111, the design substantially similarly to the pre-dip station and are shown in Figures 15A and B and 16A and B, respectively. The solutions used in the stations will, however, differ according to the desired function. For example, an alkaline solution may be used. The function of the neutralizing station 113 is to neutralize the effects of the used in the plating stations. The stripping station 119 is located toward the end of the process and its function is to strip off any solder plated on the top or bottom fingers 27,28 of the strip holder 20 before entering the loading stage. The function of the neutralizing station 113 is to neutralize the effects of the acid used in the plating stations.

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Solder, preferably a tin/lead alloy, is deposited on the leads of the mold strip during the electroplating process. Figures 17A, 17B, 18A and 18B show the electroplating stations 108 to 111. The total of four plating stations is used because of the longer time required for effective plating of the mold strip 6 relative to other stages of the plating process. Each plating station has an inner cell 26 and there is a common outer cell 25 for the four stations. The electroplating solution is pumped by a pump 12 from the outer cell 25 to the inner cells 26 via the suction 77 and discharge 76 lines as shown in Figure 17A. Any excess solution overflows from the inner cells 26 back to the outer cell 25. When the carrier 10 is in the lowered position, the contact bar 23 will come into contact with the contact bush 22, and current from the rectifier 98 (shown in Figure 21) will be supplied to the mold strip 6 through the contact bush 22, contact bar 23, spring contacts 32 and top

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fingers 28. The circuit is completed through the electroplating solution to the solder anode bar 85 or anode basket 88 with solder balls, which are electrically connected to the rectifier. In this way, the solder is plated on to the mold strip 6. A level sensor 74 is used to protect the chemical pump 12. If the solution is low, this will be detected by the level
5 sensor 74 and the chemical pump 12 will be cut off automatically by a programmable logic controller (not shown). Exhaust suction pipes 80 are provided to draw away any fumes arising from the electroplating stations. When the carrier 10 moves upward, the air knife 70, located at the last plating station 111, is activated so as to blow any residual solution from the mold strip 6 and the strip holder 20 which may otherwise be carried over to next
10 station.

After the final electroplating station 111, the carrier 10 moves the mold strips 6 to the water rinse 112 which is followed by the neutralizing station 113. After two more water rinsing stations 114 and 115, the mold strip 6 is subjected to air drying with an air knife
15 70 at air blow station 116, as shown in Figures 19A and 19B. This serves to remove any excess water on the mold strip 6 and strip holder 20. Preferably, the air knife 70 at the air blow station 116 is configured to be able to move up and down on both sides of the mold strip 6 and mold strip holder 20 once the carrier 10 is in the lowered position. The air knife up/down movement is operated by an air cylinder.

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The next process step is the air drying station 117, shown in Figures 20A and 20B. When the carrier 10 is in the lowered position, the dryer 95 will feed hot air from the hot air supply 94 on to the mold strip 6. Preferably, the air drying station 117 includes a temperature sensor in the form of a thermocouple, a hot air gun for producing heat, and
25 air blower for producing air through the hot air gun. The mold strip 6 is then unloaded at the unloading station 118.

It is preferred to operate the plating machine 1 by stepping it through a series of process steps. In normal operation and when the carrier 10 is in the lowered position, it is
30 envisaged that each of the process stations 102 to 117 will be treating a mold strip 6, the loading fork 50 will be loading a mold strip 6 into a mold strip holder 20 and the

unloading fork 60 will be unloading a mold strip 6 from a strip holder 20. During this time, there are no mold strip 6 held by the strip holders 20 in the process stations 119 and 120, as these stations are for cleaning the strip holders 20. After a predetermined period of time passes with the carrier 10 in the lowered position, the carrier 10 will be driven to its
5 raised position and will then rotate by a fixed amount so that each of the strip holders 20 is positioned above the next station. The carrier 10 will then be driven to its lowered position again and thus complete a carrier increment cycle. For at least one mold strip 6, each of these steps is repeated until it has visited each of the process stations 101 to 118, including loading and unloading. Under normal operation, each of the process stations 102 to 117
10 will be treating a mold strip 6 in each cycle, and while at least one mold strip 6 will be loaded into a strip holder 20 at station 101, another will be unloaded at station 118. This will produce a treated, soldered mold strip 6 for each carrier increment cycle.

The above description has been made on the basis that the preferred movement of the
15 carrier 10 is to be clockwise, but it is equally within the scope of the present invention that the direction of movement be counter-clockwise or a combination of the two. Accordingly, other alterations and modifications of the present invention may be apparent to those skilled in the art without departing from the spirit and scope of the present invention.

Claims:

1. An apparatus for solder plating at least one work piece, the apparatus including:
a frame;
a carrier mounted on the frame for rotation about a generally vertical axis and
5 having a plurality of work piece holders;
a plurality of process stations arranged in a circular array, at least some of said
process stations including electrolytic solutions;
said work piece holders each having top and bottom fingers for holding respective
work pieces;
10 indexing means for moving the carrier so that work pieces held thereon are moved
to successive process stations, the indexing means being operable to move the carrier
between raised and lowered positions as it moves the work pieces to successive stations;
a plurality of first contacts which are fixed in position relative to the process
stations; and
15 a plurality of second contacts which are fixed in position relative to the carrier; and
wherein the indexing means is operable to cause selected first and second contacts
to engage one another when the carrier is in said lowered position to thereby enable
electrical connections to be established with the process stations which include said
electrolytic solutions.
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2. The apparatus as claimed in claim 1, wherein said top fingers provide electrical
contact with said work piece.
3. The apparatus as claimed in claim 2, wherein said bottom fingers also provide
25 electrical contact with said work piece.
4. The apparatus as claimed in claim 1, wherein each work piece holder holds one of
said work pieces in a radial orientation about said vertical axis.
- 30 5. The apparatus as claimed in claim 1, wherein when said carrier is in said lowered
position and selected ones of said first and second contacts engage one another, said at



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least one work piece is at least fully immersed in one of said electrolytic solutions and thereby completes an electric circuit.

6. The apparatus as claimed in claim 5, wherein said electric circuit is powered by a
5 power supply.

7. The apparatus as claimed in claim 6, wherein each of the process stations which includes an electrolytic solution further includes at least one anode or cathode.

10 8. The apparatus as claimed in claim 7, wherein in said electric circuit, electrical connections are made between said power supply and one of said first contacts, between said one of said first contacts and said at least one work piece, between said at least one anode or cathode and said work piece via said electrolytic solution, and between said at least one anode or cathode and said power supply.

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9. The apparatus as claimed in claim 1, wherein at least one of said process stations is a water rinsing station.

10. The apparatus as claimed in claims 1 or 9, wherein at least one of said process
20 stations has an air knife for removing excess liquid from said at least one work piece.

11. The apparatus as claimed in claim 1, wherein at least one of said process stations includes an air dryer for drying said at least one work piece.

25 12. The apparatus as claimed in claim 1, wherein at least one of said process stations includes means for stripping off any solder plated on the top or bottom fingers.

13. The apparatus as claimed in claim 1, wherein a plurality of said process stations includes an inner cell.

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14. The apparatus as claimed in claim 1, wherein each of said process stations includes



an outer cell.

15. The apparatus as claimed in claim 1, wherein said process stations include a loading station for loading said at least one work piece into a respective one of said work
5 piece holders.

16. The apparatus as claimed in claims 1 or 15, wherein said process stations include an unloading station for unloading said at least one work piece from a respective one of said work piece holders.

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17. A method for solder plating at least one work piece, including the steps of:

loading said at least one work piece into a respective one of a plurality of work piece holders, said work piece holders being located on a carrier and having a plurality of top and bottom fingers for holding respective ones of said at least one work piece, said
15 carrier having raised and lowered positions and being rotatable about a vertical axis;

rotating said carrier in a circular path so that said work piece holders are suspended on said carrier over a plurality of process stations arranged below said work piece holders in said circular path, at least some of the process stations including a plurality of electrolytic solutions;

20 moving said carrier to said lowered position to cause engagement of first contacts, which are fixed in position relative to the process stations, with selected second contacts, which are movable with the carrier, to thereby enable electrical connections to be established with the process stations which include said electrolytic solutions.

25 18. The method as claimed in claim 17, further including the step of moving said carrier to said raised position after a predetermined period of time.

19. The method as claimed in claims 17 or 18, wherein said top fingers provide electrical contact with said work piece.

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20. The method as claimed in claim 19, wherein said bottom fingers also provide



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electrical contact with said work piece.

21. The method as claimed in claim 19, wherein each work piece holder holds one of said work pieces in a radial orientation about said central vertical axis.

5 22. The method as claimed in claim 17, wherein when said carrier is in said lowered position and selected ones of said first and second contacts engage one another, said at least one work piece is at least fully immersed in one of said electrolytic solutions and thereby completes an electric circuit.

10 23. The method as claimed in claim 22, wherein said electric circuit is powered by a power supply.

24. The method as claimed in claim 23, wherein each of the process stations which includes an electrolytic solution includes at least one anode or cathode.

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25. The method as claimed in claim 24, wherein in said electric circuit, electrical connections are made between said power supply and one of said first contacts, between said one of said first contacts and said at least one work piece, between said at least one anode or cathode and said work piece via said electrolytic solution, and between said at
20 least one anode or cathode and said power supply.

26. The method as claimed in claims 17 or 18, wherein at least one of said process stations is a water rinsing station.

25 27. The method as claimed in claim 26, wherein at least one of said process stations has an air knife for removing excess liquid from said at least one work piece.

28. The method as claimed in claims 17 or 18, wherein at least one of said process stations includes an air dryer for drying said at least one work piece.

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29. The method as claimed in claim 17 or 18, wherein at least one of said process



stations includes means for stripping off any solder plated on the top or bottom fingers.

30. The method as claimed in claims 17 or 18, wherein a plurality of said process stations includes an inner cell.

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31. The method as claimed in claims 17 or 18, wherein each of said process stations includes an outer cell.

32. The method as claimed in claim 18, wherein said process stations include a loading
10 station for loading said at least one work piece into a respective one of said work piece holders.

33. The method as claimed in claim 32, wherein said process stations include an
unloading station for unloading said at least one work piece from a respective one of said
15 work piece holders.

