



(51) International Patent Classification:

B23K 1/008 (2006.01) *F27B 9/30* (2006.01)
B23K 3/04 (2006.01) *F27B 9/34* (2006.01)
B23K 3/08 (2006.01) *F27D 1/10* (2006.01)
C09D 133/00 (2006.01) *F27D 1/16* (2006.01)

(21) International Application Number:

PCT/US2016/032369

(22) International Filing Date:

13 May 2016 (13.05.2016)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/164,855 21 May 2015 (21.05.2015) US
 15/153,349 12 May 2016 (12.05.2016) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: REFLOW OVEN LINER WITH A SUBSTRATE AND AN ADHESIVE LAYER, AND A METHOD FOR TREATING THE SURFACE OF A REFLOW OVEN

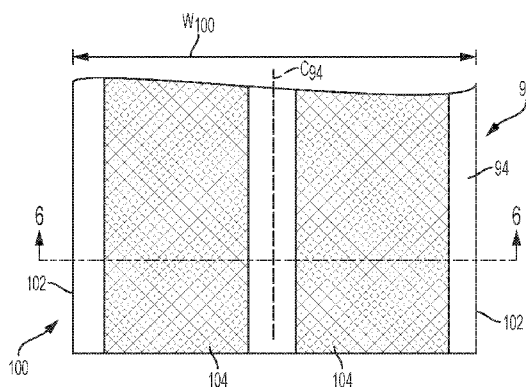


FIG. 5

(57) Abstract: A liner (92) for contamination control in a reflow oven, which reflow oven has surfaces, includes a substrate (94) having a length and a width defining an area. The substrate (94) has a thickness defined by first and second sides. An adhesive is positioned on the first side of the substrate (94). The substrate (94) is removably adhered to the surfaces of the reflow oven, and the liner (92) is configured to accumulate solder reflow contaminants thereon or to repel solder flux vapors and/or fumes, and is configured for removal from the surfaces with any accumulated contaminants. A method of treating the surfaces of a reflow oven is also disclosed.



TITLE

REFLOW OVEN LINER WITH A SUBSTRATE AND AN ADHESIVE LAYER, AND A METHOD FOR TREATING THE SURFACE OF A REFLOW OVEN

CROSS-REFERENCE TO RELATED APPLICATION DATA

[0001] This application claims the benefit of and priority to Provisional U.S. Patent Application Serial No. 62/164,855, filed May 21, 2015, the disclosure of which is incorporated herein in its entirety.

BACKGROUND

[0002] Electronic components are often surface mounted onto a printed circuit board using a reflow process. Such a process is carried out in a reflow soldering oven that is designed to heat the printed circuit board during the reflow process.

[0003] In the fabrication of printed circuit boards, electronic components are often surface mounted to a bare board by a process known as "reflow soldering." In a known reflow soldering process, a pattern of solder paste is deposited onto the circuit board and the leads of one or more electronic component are inserted into the deposited solder paste. The circuit board is then passed through an oven where the solder paste is reflowed (i.e., heated to a melt or reflow temperature) in the heated zones of the oven and then cooled in a cooling zone of the oven to electrically and mechanically connect the component leads to the circuit board. For purposes of the present disclosure the term "circuit board" or "printed circuit board" includes any type of substrate assembly of electronic components, including, for example, wafer substrates.

[0004] Known reflow ovens have a heating chamber or zone and a cooling chamber or zone. Soldering flux, which is a component of solder paste, facilitates proper flow of the solder paste. In the heating and cooling zones, some portions of the flux and flux decomposition products vaporize. Possible subsequent flux condensation on cooler surfaces on the ovens requires extraction and collection of the flux vapors away from the heating and cooling chambers to maintain consistent processing. To achieve flux removal, two types of reflow ovens--air reflow ovens and inert atmosphere reflow ovens are used. In air reflow ovens, flux is extracted by an exhaust system. In inert atmosphere reflow ovens, a flux management system is used to extract flux from the heating/cooling chambers.

[0005] Contaminant buildup occurs at various locations in the reflow oven. For example, at the oven entrance, the buildup of adipic acid with little amine may occur. In the cooling zone, resin/rosin decomposition products may be seen.

[0006] Both flux removal systems suffer from well-known shortcomings. With both systems, flux continues to deposit onto the bottom or floor and inner walls of the heating/cooling chambers. Over time, the flux collected on the chamber floor and walls creates problems during production as excess flux may drip back onto actual production printed circuit boards, which can potentially contaminate or otherwise compromise the attachment of components onto the printed circuit boards.

[0007] Under current production requirements, it is desired to continuously operate fabrication equipment, including reflow ovens. As such, when contemplating scheduled maintenance of the fabrication equipment, it is also desirable to keep down-time as short as possible. During scheduled maintenance, the removal of flux on chamber walls is generally not addressed. Thus, there may be an ongoing and exaggerated flux contamination exposure of the printed circuit boards being produced. Over time, excess flux may also cause premature failures of components of the reflow oven, including blowers designed to facilitate air circulation within the reflow oven chamber.

[0008] Ngai, US 8,940,099, commonly assigned with the present application and incorporated herein in its entirety, discloses a reflow oven that has a chamber housing including surfaces that are in contact with heated air mixed with contaminants, including flux, which surface are coated with a water-soluble layer selectively applied to the surfaces of the chamber housing, and a method of treating the surfaces of a reflow oven. The oven surfaces are coated with an acrylic-based layer, such as an acrylic paint.

[0009] While such a coating functions well to facilitate cleaning oven surfaces, there are a number of drawbacks. First, the latex material contains certain undesirable constituents such as phthalates. In addition, the curing time is longer than desired and can be as much as 4-5 hours. The latex material is brush or roller applied and as such, may be messy or difficult to apply and may not apply evenly on the oven surfaces. In certain cases, the latex material, which has a temperature limitation of about 100°C, may not be sufficiently high for reflow oven operations.

[0010] Accordingly there is a need for a liner, system and method for reflow oven contamination control and cleaning. Desirably, such a system is easy to use and/or apply, remove and reapply. More desirably, such a system and method functions well over a wider variety of operating temperatures and over temperatures that cover the operating temperatures of ovens in the reflow process. More desirably still, such a system and method allow for application using standard or known tools.

SUMMARY

[0011] A liner for contamination control in a reflow oven is easy to use and/or apply, remove and reapply. A typical reflow oven includes surfaces, such as side walls, a bottom wall and a top wall. The liner and system include a substrate having a length and a width that define an area. The substrate has a thickness defined by first and second sides.

[0012] An adhesive is positioned or applied on the first side of the substrate. The substrate is removably adhered to the surfaces of the reflow oven and is configured to accumulate solder reflow contaminants thereon and is further configured for removal from the surfaces with the accumulated contaminants.

[0013] In an embodiment, the liner is in the form of a strip of material removably adhered to the surfaces. The adhesive can be present as one or more strips positioned longitudinally along a length of the strip of material. The adhesive can be positioned longitudinally along the strip parallel to longitudinal axis of the strip of material. In an embodiment, three strips of adhesive are positioned along the strip of material, two of the adhesive strips positioned at about outer edges of the strip and a third adhesive strip positioned therebetween.

[0014] In an embodiment, the substrate is formed from a heat tolerant material compatible with reflow oven temperatures up to and including about 220°C and the adhesive is formed from a heat tolerant material compatible with reflow oven temperatures up to and including about 220°C. The adhesive is non-curing up to the reflow oven temperature of about 220°C, such that the adhesive does not set-up or cure and is readily removable from the oven surfaces after heat-up and cool down. In an embodiment, the strip (i.e., the adhesive) is removable from the surfaces at a temperature of less than about 50°C. In an embodiment, the adhesive covers less than an entirety of the first side.

[0015] The liner can include a contaminant absorbing material positioned on the second side of the substrate. The contaminant absorbing material is formed from a heat tolerant material compatible with reflow oven temperatures up to and including about 220°C. Alternately, the liner can include a material that is specifically repellant to flux vapors and fumes on the second side of the substrate to inhibit condensation and accumulation of contaminants so they are collected away from the chambers.

[0016] A method for treating the surfaces of a reflow oven for contamination control includes applying a substrate having a length and a width that define an area and a thickness defined by first and second sides one or more surfaces of the reflow oven. In an embodiment, the substrate is formed from a heat tolerant material compatible with reflow oven temperatures up to and including about 220°C.

[0017] The substrate is adhered to the one or more surfaces using a heat tolerant adhesive compatible with reflow oven temperatures up to and including about 220°C. The substrate is removably adhered to the surfaces of the reflow oven and the liner is configured to accumulate solder reflow contaminants thereon and configured for removal from the surfaces with the accumulated contaminants.

[0018] In a method, the substrate is applied in strips. Multiple strips of substrate can be applied to the surfaces. In an embodiment, the edges of the strips overlap edges of adjacent strips. In an alternate embodiment, the strips abut one another and do not overlap.

[0019] In an embodiment, the adhesive is discontinuously applied to the substrate. The adhesive can be applied to less than an entirety of the first side of the substrate. The method can include a substrate having a contaminant absorbing material on a second side, opposite of the adhesive. Alternately, the method can include having a flux vapor and fume repellant material positioned on the second side of the substrate.

[0020] These and other features and advantages of the present invention will be apparent from the following detailed description, in conjunction with the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] FIG. 1 is a perspective view of an example of a surface mounted technology (SMT) production line illustrating, among the components, a reflow oven in which a reflow oven liner and method may be used;

- [0022] FIG. 2 is a schematic view of an example of a reflow oven;
- [0023] FIG. 3 is a perspective view of a reflow oven chamber;
- [0024] FIG. 4 is a schematic cross-sectional view of an interior of the reflow oven chamber;
- [0025] FIG. 5 is a schematic top view illustrating one embodiment of a liner of the present disclosure;
- [0026] FIG. 6 is a cross-sectional illustration of the liner of FIG. 5 taken along line 6--6 of FIG. 5;
- [0027] FIG. 7 is a bottom view of the liner of FIG. 5;
- [0028] FIGS. 8A and 8B illustrate two examples of liners as they are applied in an oven; and
- [0029] FIG. 9 illustrates a roll form, which is one way in which the liners can be packaged for handling and use.

DETAILED DESCRIPTION

[0030] While the present device is susceptible of embodiment in various forms, there is shown in the figures and will hereinafter be described a presently preferred embodiment with the understanding that the present disclosure is to be considered an exemplification of the device and is not intended to be limited to the specific embodiment illustrated.

[0031] Solder paste is routinely used in the assembly of printed circuit boards, where the solder paste is used to join electronic components to the circuit board. Solder paste includes solder for joint formation and flux for preparing metal surfaces for solder attachment. The solder paste may be deposited onto the metal surfaces (e.g., electronic pads) provided on the circuit board by using any number of application methods. Leads of an electronic component are aligned with and impressed into solder deposited on the pads to form the assembly. In a reflow soldering processes, the solder is then heated to a temperature sufficient to melt the solder and cooled to permanently couple the electronic component, both electrically and mechanically, to the circuit board. The solder typically includes an alloy having a melting temperature lower than that of the metal surfaces to be joined. The temperature must be sufficiently low so as to not cause damage to the electronic component. In certain embodiments, the solder may be a tin-lead alloy. However, solders employing lead-free materials may also be used.

[0032] In the solder, the flux typically includes a vehicle, solvent, activators and other additives. The vehicle is a solid or nonvolatile liquid that coats the surface to be soldered and can include rosin, resins, glycols, polyglycols, polyglycol surfactants, and glycerin. The solvent, which evaporates during the pre-heat and soldering process, serves to dissolve the vehicle activators, and other additives. Examples of typical solvents include alcohols, glycols, glycol esters and/or glycol ethers and water. The activator enhances the removal of metal oxide from the surfaces to be soldered. Common activators include amine hydrochlorides, dicarboxylic acids, such as adipic or succinic acid, and organic acids, such as citric, malic or abietic acid. Other flux additives can include surfactants, viscosity modifiers and additives for providing low slump or good tack characteristics for holding the components in place before reflow.

[0033] One example of a surface mounted technology process line, illustrated generally at 10, is shown in FIG. 1. The example process line 10 includes a printed circuit board (PCB) loader 12, a screen printer 14 to apply, deposit or print the solder onto the PCB, a pick and place station 16 at which components are placed onto the PCB, and a visual inspection station 18 to assure proper placement of the components.

[0034] The process line 10 includes a reflow oven 20 in which the solder is heated to melting to electronically connect and mechanically secure the components to the PCB. The assembled PCB is subsequently cooled, tested in an in-circuit tester 22 and an unloaded at an unloading station 24. Those skilled in the art will recognize and appreciate the SMT process line as well as the possible variations on and from the example line illustrated and described.

[0035] One example of a reflow oven 20 is shown in FIG. 2 and includes, generally, a reflow oven chamber 26 in the form of a thermally insulated tunnel defining a passage for pre-heating, reflowing and then cooling solder on a circuit board passing through the chamber. The reflow oven chamber 26 extends across a plurality of heating zones, including, in one example, three pre-heat zones 28, 30, 32 followed by three soak zones 34, 36, 38, each soak zone having top and bottom heaters 40, 42, respectively. The soak zones 34, 36, 38 are followed by four spike zones 44, 46, 48, 50, for example, which likewise include heaters 40, 42. And finally, three cooling zones 52, 54, 56 follow the spike zones 44, 46, 48, 50.

[0036] A circuit board assembly 58, including deposited solder paste and electronic components, is conveyed left-to-right in FIGS. 1 and 2, and in the reflow oven 20,

through each zone of the chamber 26 on a conveyor 60. This provides for controlled and gradual pre-heat, reflow and post-reflow cooling of the circuit board assembly. In the preliminary pre-heat zones 28, 20, 32, the board is heated from ambient temperature up to the flux activation temperature, which may range between about 130°C and about 150°C for lead-based solders and higher for lead-free solders.

[0037] In the soak zones 34, 36 38, variations in temperature across the circuit board assembly are stabilized and time is provided for the activated flux to clean the component leads, electronic pads and solder powder before reflow. Additionally, volatile organic compounds (VOCs) in the flux are vaporized. The temperature in the soak zones 34, 36, 38 is typically about 140°C to about 160°C for lead-based solders and higher for lead-free solders. In certain embodiments, the circuit board assembly may spend about thirty to about forty-five seconds passing through the soak zones 34, 36, 38.

[0038] In the spike zones 44, 46, 48, 50, the temperature quickly increases to a temperature above the melting point of the solder to reflow the solder. The melting point for eutectic or near-eutectic tin-lead solder is about 183°C, with the reflow spike being typically set about 25°C to about 50°C above the melting point to overcome a pasty range of molten solder. For lead-based solders, a typical maximum temperature in the spike zones is in the range of about 200°C to about 220°C. Temperatures above about 225°C may cause baking of the flux, damage to the components and/or sacrifice joint integrity. Temperatures below about 200°C may prevent the joints from fully reflowing. In an embodiment, the circuit board assembly is typically maintained at a temperature within the spike zones 44, 46, 48, 50 above the reflow temperature for about one minute.

[0039] In the cooling zones 52, 54, 56, the temperature drops below the reflow temperature, and the circuit board assembly is cooled sufficiently to solidify the joints and thereby preserve joint integrity before the circuit board assembly leaves the reflow oven chamber 12. A flux extraction/filtration system (not shown) may be provided to remove contaminant materials from the gas generated by the reflow soldering oven 20.

[0040] Turning now to FIGS. 3 and 4, the several zones (e.g., pre-heat zones 28, 30, 32, soak zones 34, 36, 38, and/or spike zones 44, 46, 48, 50) including heaters 40, 42 of the reflow oven include a reflow oven chamber assembly, which is generally indicated at 64. In the illustrated embodiment, the reflow oven chamber assembly 64 may include one or more zones.

It should be noted that the reflow oven chamber assembly 64 may be configured to have any suitable number of zones needed or required within the reflow soldering oven. Also, it should be noted that FIG. 4 illustrates the upper reflow oven chamber assembly 64. A similar lower reflow oven chamber assembly may be provided in addition to or in lieu of the upper reflow oven chamber assembly to deliver heated air from below the printed circuit board as the board travels through the reflow oven.

[0041] Referring to FIG. 4, the reflow oven chamber assembly 64 includes, in an embodiment, a rectangular-shaped chamber housing, indicated at 66, having a top 68, two relatively longer sides 70, 72, two relatively shorter ends 74, 76, and a bottom, which functions as a diffuser plate 78. In one embodiment, the chamber housing 66 is fabricated from stainless steel. An air blower device 80 is provided on the top 68 of the chamber housing 66 to direct air from an inlet 82 provided in the top 68 of the chamber housing 66 to the reflow oven chamber 26. Air is exhausted out of plenums 84, 86 provided along respective sides 70, 72 of the chamber housing 66 toward an outlet 88, which is also provided in the top 68 of the chamber housing 66. The chamber housing 66 is configured to enclose and mount the components of the reflow oven chamber assembly 64, and to be suitably secured within the reflow oven chamber 26 of the reflow soldering oven 20.

[0042] The diffuser plate 78 distributes air from the reflow oven chamber assembly 64 to the reflow oven chamber 26. The diffuser plate 78 can include holes in a pattern, such as the illustrated staggered pattern, to provide consistent, uniform airflow to the printed circuit board 58. These holes can be stamped from sheet metal material such that they form a converging nozzle that results in a uniform airstream. The arrangement is such that air flows through the reflow oven chamber assembly 64 generated by the air blower device 80 with air entering the inlet 82 and exiting the diffuser plate 78. Air can enter the inlet 82 as illustrated by arrows A and exit through the outlet 88 as illustrated by arrows B through the plenums 84, 86.

[0043] Referring now to FIGS. 4-7, in order to address flux deposition on the bottom or floor and inner walls of the heating/cooling chambers, the surfaces 89 of the chamber housing 66, including the diffuser plate 78 and the plenums 84, 86, may be treated with a layer of removable material, indicated generally at 90, to enable the easy removal of flux and other contaminants that build up over time on these surfaces 89. In an embodiment the material includes a reflow oven liner system 92 having a base material or substrate 94 and an adhesive 96

to removably secure the substrate 94 to the chamber surfaces 89. The substrate 94 has certain characteristics that permit its use in the reflow oven 20 environment, that is, at temperatures up to and including about 220°C. Suitable substrate 94 materials include foils, temperature tolerant non-metals, such as cotton-based or glass fibers in the form of films, and the like.

[0044] The adhesive 96 is present on a side 98 of the substrate 94 to temporarily secure the substrate 94 to the chamber surfaces 89. The adhesive 96, similar to the substrate 94, is a heat tolerant material that must retain its adhesive characteristics at elevated temperatures and not cure or harden as a result of being held at such temperatures. The adhesive 96 must also be of the type that can be readily removed from the chamber surfaces 89 after being subjected to elevated temperatures and be removable from the surfaces 89, with the substrate 94, at about ambient temperatures or slightly elevated temperatures, for example at or about 50°C.

[0045] In an embodiment, the substrate 94 is in the form of flexible strips 100 of material and the adhesive 96 is disposed, at least in part, along portions of edges 102 of the substrate 94. This effectively permits applying the liner system 92 to the surfaces 89 in strips 100 that are readily applied and removed when replacement is desired. In an embodiment, the strips 100 are formed in widths w_{100} of about 2 to about 3 inches.

[0046] In an embodiment, the liner strips 100 include an absorbent 104 or other material to help contain the contaminants. The flux absorbent material 104 can be positioned on a side 106 of the substrate 94 opposite the adhesive 96 so that the absorbent 104 is facing inward of the chamber 64. The absorbent material 104 can also be applied to or positioned on the substrate 94 in a variety of patterns, such as the elongated strip 100 pattern shown. In an embodiment, the liner 100 includes a material, also shown at 104 for illustrative purposes, that is specifically repellant to flux vapors and fumes on the second side 106 of the substrate 94. The repellant material inhibits condensation and accumulation of the flux vapors and fumes (and contaminants) so that these materials are collected away from the chamber surfaces 89. Other patterns and areas of coverage will be appreciated by those skilled in the art and are within the scope and spirit of the present disclosure.

[0047] In an embodiment the adhesive 96 is present as three parallel strips 96a,b,c running longitudinally along the substrate 94, parallel to a centerline C_{94} of the substrate 94. The absorbent or repellant material 104 is present as two parallel strips 104a,b running longitudinally along the substrate 94, parallel to a centerline C_{94} of the substrate 94 on the side 106 of the

substrate 94 opposite the adhesive 96. In such an arrangement, the adhesive 96 can be, for example, a self-stick adhesive having a release layer, a water activated adhesive, a tacky adhesive that permits overlapping layers of the strips 100 onto one another (to, for example, store the liner strips in roll form), or any other suitable arrangement, configuration and/or formulation. In one embodiment, the liner 92 is supplied on rolls R, a cross-section of which is as illustrated in FIG. 9. It is anticipated that a roll-form R of the liner system 92 can be provided and used in cooperation with a tape applicator, such as a commonly known tape gun, to facilitate application to the chamber surfaces. In the illustrated cross-section of the roll R in FIG. 9, it will be appreciated that in the roll R form, the absorbent or repellant material 104 of a lower layer in the roll will reside between the adhesive strips 96 of an upper layer so as to provide a compact and easily usable liner system roll R.

[0048] In application, the liner 92 can be positioned or applied in, for example, a side-by-side application, as illustrated in FIG. 8A, in which the edges 102 of adjacent liners 92a,b are abutting one another, or in an overlapping manner, as illustrated in FIG. 8B in which edge regions 108 of adjacent liners 192a, 192b overlap to ensure complete coverage of the surfaces 89. It will be appreciated that although the illustration of FIG. 8B shows that the liner 192a is elevated above the surface 89, that the liner 192a is flexible and will conform, curve or bend at the juncture of the liners 192a and 192b so that liner 192a will lie flat on the surface 89 other than immediately at the juncture.

[0049] A method for treating the surfaces 89 of a reflow oven for contamination control includes applying a substrate 94 having a length and a width that define an area and a thickness t_{94} defined by first 98 and second 106 sides onto one or more surfaces 89 of the reflow oven 20. In an embodiment, the substrate 94 is formed from a heat tolerant material compatible with reflow oven 20 temperatures up to and including about 220°C.

[0050] The substrate 94 is adhered to the one or more surfaces 89 using a heat tolerant adhesive 96 also compatible with reflow oven 20 temperatures up to and including about 220°C. The substrate 94 is removably adhered to the surfaces 89 of the reflow oven 20 and the liner 92 is configured to accumulate solder reflow contaminants thereon and configured for removal from the surfaces 89 with the accumulated contaminants. The liner 92 can be readily removed by hand or with commonly available tools. It is anticipated that the liner 92 will remove easily (e.g., in one piece) with only nominal effort.

[0051] In a method, the liner 92 is applied in strips 100. Multiple strips 100a,b of the liner system 92 can be applied to the surfaces 89. In an embodiment, the edge regions 108 of the a strip 100a overlaps edges 108 of an adjacent strip 100b (see, e.g., FIG. 8B). In an alternate embodiment, the strips 100 abut one another and do not overlap (see, e.g., FIG. 8A).

[0052] In an embodiment, the adhesive 96 is discontinuously applied to the substrate 94. The adhesive 96 can be applied to less than an entirety of the first side 98 of the substrate 94, for example in stripe (as seen in e.g., FIG. 7), in dots, in a sinuous pattern, and the like. In an embodiment of the method, a substrate 94 has a contaminant absorbing or a contaminant repellant material 104 on a side 106 opposite of the adhesive 96. That is, the method can include providing a contaminant absorbing material 104 one a side 106 of the substrate 94 or providing a contaminant repelling material (again, also indicate generally at 104) on a side 106 of the substrate 94.

[0053] It will be understood that the adhesive 96 is one that does not cure or become permanently adhered to the chamber surfaces 89. Rather, the adhesive 96 should be selected so that even with repeated heat-up and cool-down cycles, the adhesive 96 will retain such characteristics that allow it to be readily removed from the chamber surfaces 89 with nominal or minimal effort.

[0054] It will also be appreciated that the present liner, system and method for reflow oven contamination control and cleaning provide a system that is easy to use and/or apply, remove and reapply. The present liner, system and method function well over a wide variety of operating temperatures and over temperatures that cover the operating temperatures of reflow ovens in the reflow process and allow for application using standard or known tools and methods.

[0055] It will be appreciated by those skilled in the art that the relative directional terms such as upper, lower, rearward, forward and the like are for explanatory purposes only and are not intended to limit the scope of the disclosure.

[0056] All patents referred to herein, are hereby incorporated herein by reference, whether or not specifically done so within the text of this disclosure.

[0057] In the present disclosure, the words “a” or “an” are to be taken to include both the singular and the plural. Conversely, any reference to plural items shall, where appropriate, include the singular.

[0058] From the foregoing it will be observed that numerous modifications and variations can be effectuated without departing from the true spirit and scope of the novel concepts of the present disclosure. It is to be understood that no limitation with respect to the specific embodiments illustrated is intended or should be inferred. The disclosure is intended to cover all such modifications as fall within the scope of the claims.

CLAIMS

1. A liner for contamination control in a reflow oven, the reflow oven having surfaces, comprising:
 - a substrate having a length and a width defining an area, the substrate having a thickness, the substrate having first and second sides; and
 - an adhesive positioned on the first side of the substrate,wherein the substrate is removably adhered to the surfaces of the reflow oven, the liner configured to accumulate solder reflow contaminants thereon and configured for removal from the surfaces with the accumulated contaminants.
2. The liner of claim 1 wherein the liner is in the form of a strip of material removably adhered to the surfaces.
3. The liner of claim 2 wherein the adhesive is present as strip positioned longitudinally along a length of the strip of material.
4. The liner of claim 3 wherein the adhesive is positioned longitudinally along the strip of material parallel to longitudinal axis of the strip of material.
5. The liner of claim 4 wherein three strips of adhesive are positioned along the strip of material, wherein two of the strips of adhesive are positioned at about outer edges of the strip and a third strip of adhesive is positioned therebetween.
6. The liner of claim 1 wherein the substrate is formed from a heat tolerant material compatible with reflow oven temperatures up to and including about 220°C.
7. The liner of claim 6 wherein the adhesive is formed from a heat tolerant material compatible with reflow oven temperatures up to and including about 220°C.

8. The liner of claim 7 wherein the adhesive is non-curing up to the reflow oven temperature of about 220°C, such that the adhesive does not set-up or cure and is readily removable from the surfaces.

9. The liner of claim 1 including a contaminant absorbing material positioned on the second side of the substrate.

10. The liner of claim 9 wherein the contaminant absorbing material is formed from a heat tolerant material compatible with reflow oven temperatures up to and including about 220°C.

11. The liner of claim 1 wherein the adhesive covers less than an entirety of the first side.

12. A liner for contamination control in a reflow oven, the reflow oven having surfaces, comprising:

a substrate having a length and a width defining an area, the substrate having a thickness, the substrate having first and second sides; and

an adhesive positioned on the first side of the substrate,

wherein the substrate is removably adhered to the surfaces of the reflow oven, the liner including a flux vapor and fume repelling material on the second side of the substrate and configured for removal from the surfaces of the reflow oven.

13. A method for treating the surfaces of a reflow oven, the reflow oven having surfaces, comprising:

applying a substrate having a length and a width defining an area, the substrate having a thickness, the substrate having first and second sides on a surface of the reflow oven, the substrate being formed from a heat tolerant material compatible with reflow oven temperatures up to and including about 220°C; and

adhering the substrate to the surface using a heat tolerant adhesive compatible with reflow oven temperatures up to and including about 220°C.

14. The method of claim 13 wherein the substrate is applied in strips.
15. The method of claim 15 wherein multiple strips of substrate are applied to the surfaces.
16. The method of claim 15 wherein edges of the strips overlap edges of adjacent strips.
17. The method of claim 12, wherein the substrate includes a contaminant absorbing material on a side opposite of the adhesive, the absorbent material configured to accumulate solder reflow contaminants thereon and wherein the substrate and contaminant absorbing material are configured for removal from the surfaces with the accumulated contaminants.
18. The method of claim 13 wherein the substrate includes a flux vapor and fume repelling material on a side opposite of the adhesive.
19. The method of claim 13 wherein the adhesive is discontinuously applied to the substrate.
20. The method of claim 13 wherein the adhesive is applied to less than an entirety of the first side of the substrate.

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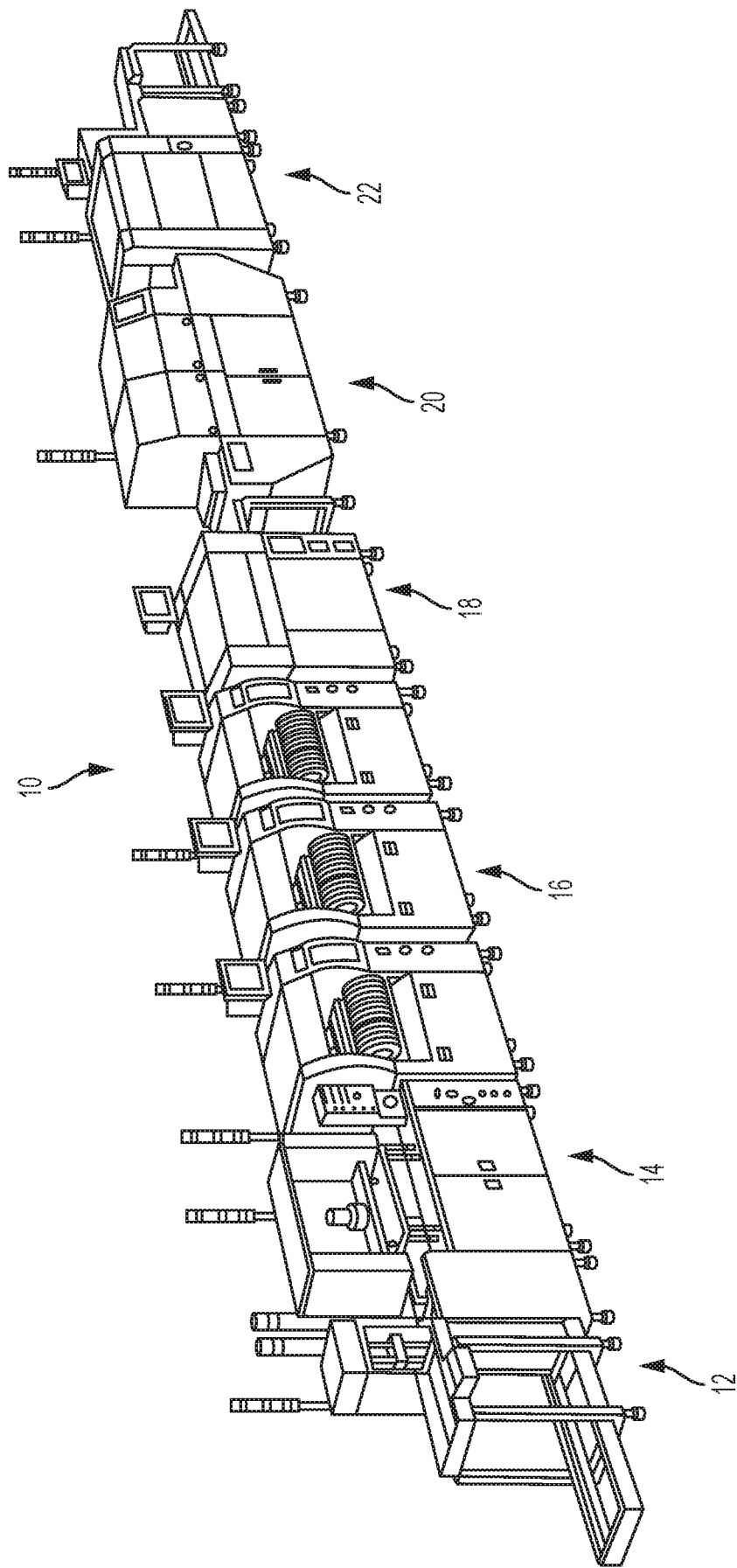


FIG. 1

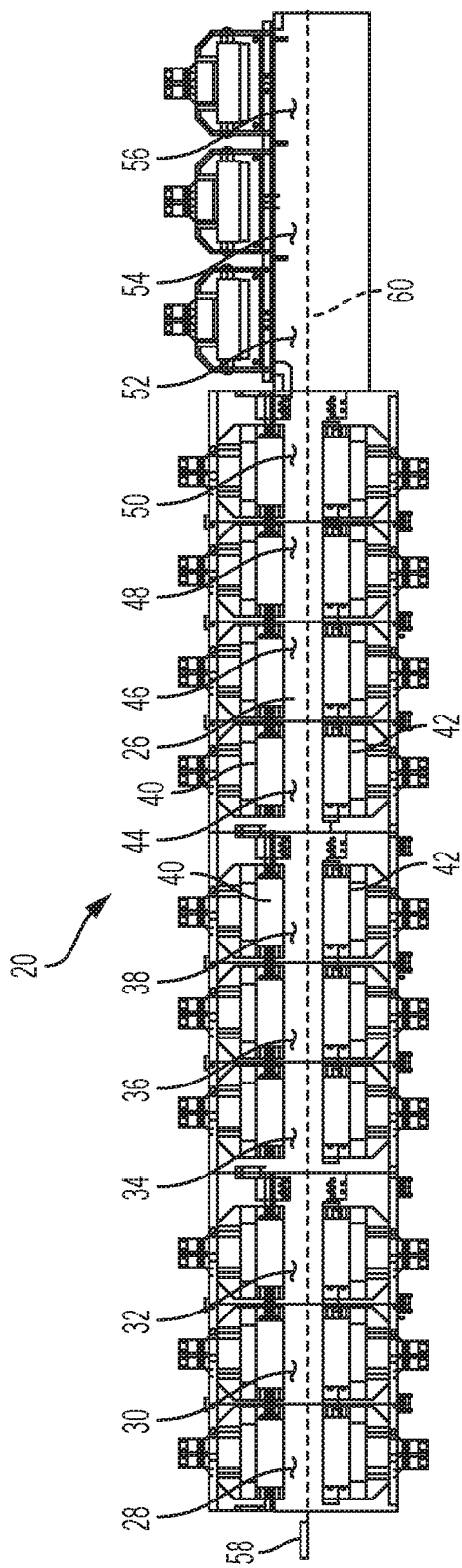


FIG. 2

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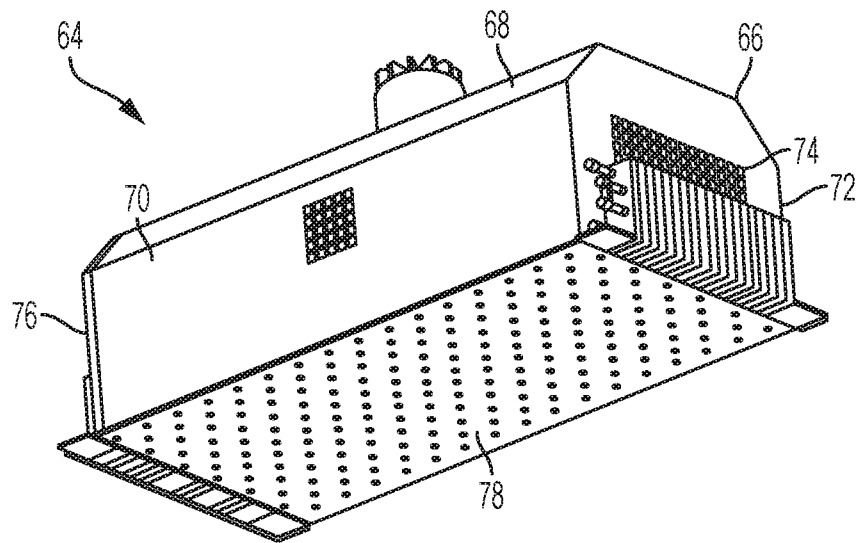


FIG. 3

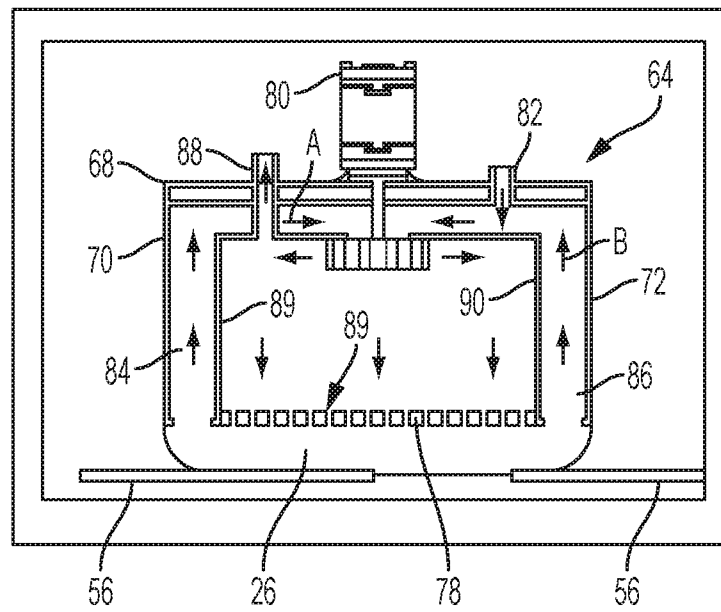


FIG. 4

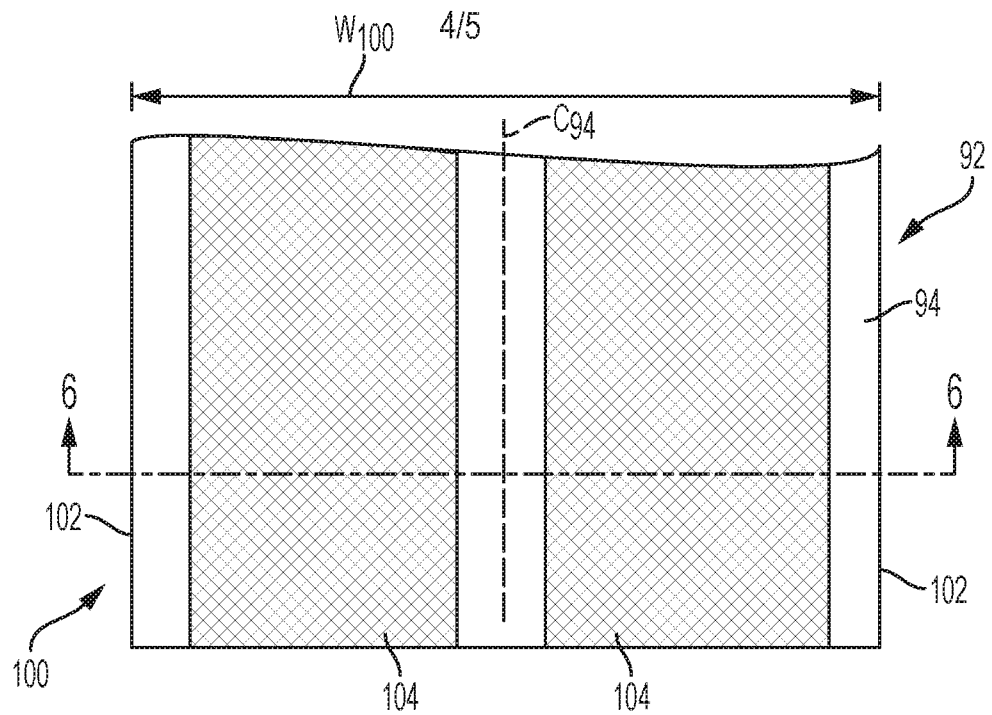


FIG. 5

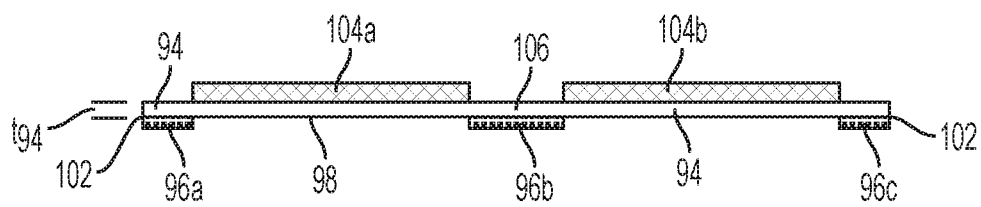


FIG. 6

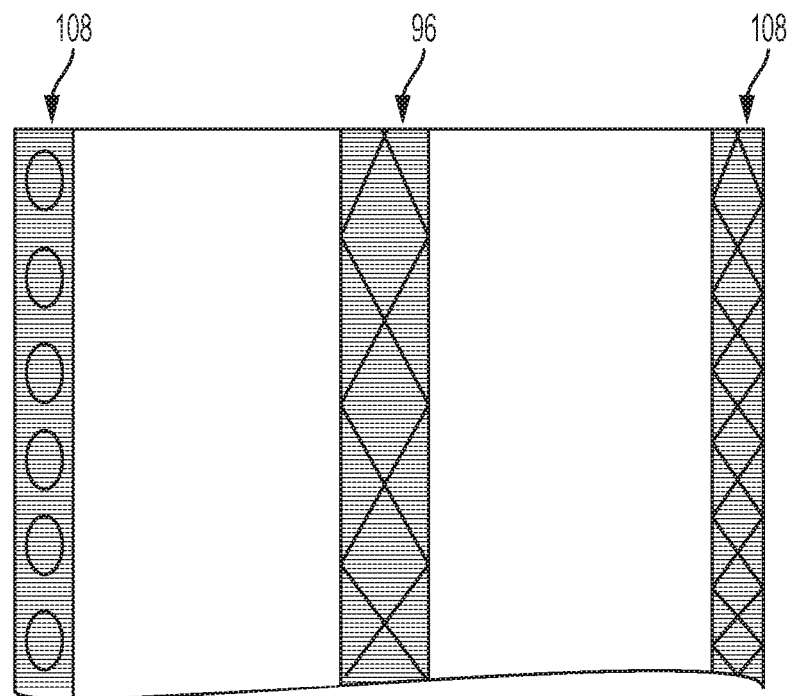


FIG. 7

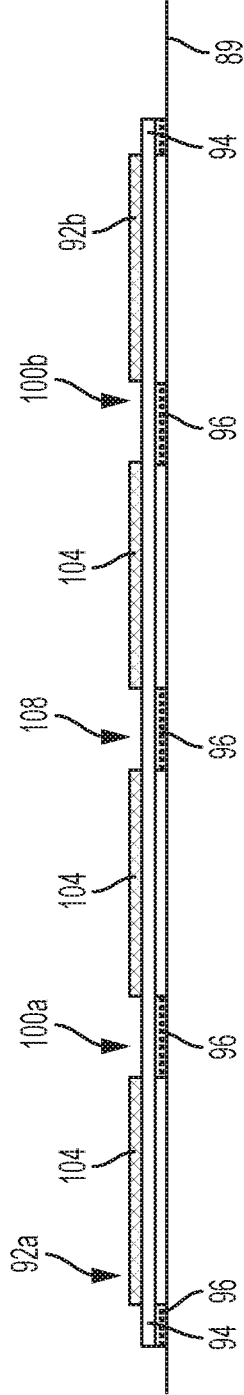


FIG. 8A

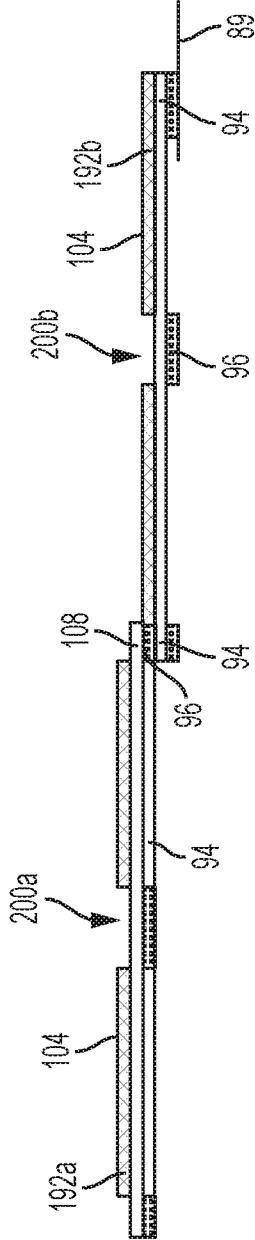


FIG. 8B

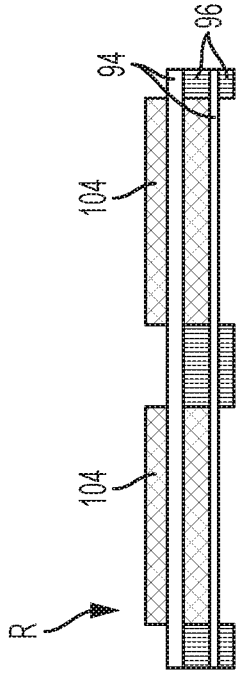


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/032369

A. CLASSIFICATION OF SUBJECT MATTER INV. B23K1/008 B23K3/04 B23K3/08 C09D133/00 F27B9/30 F27B9/34 F27D1/10 F27D1/16 ADD.														
According to International Patent Classification (IPC) or to both national classification and IPC														
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B23K C09D F27B F27D Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data														
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>US 2013/256389 A1 (D. NGAI ET AL) 3 October 2013 (2013-10-03) paragraphs [0027], [0033], [0035]; figures -----</td> <td>1-20</td> </tr> <tr> <td>X</td> <td>US 6 238 249 B1 (Y. KUWAMURA) 29 May 2001 (2001-05-29) column 7, lines 6-21; figures 12-14 -----</td> <td>1,6,7,12</td> </tr> <tr> <td>A</td> <td></td> <td>13</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 2013/256389 A1 (D. NGAI ET AL) 3 October 2013 (2013-10-03) paragraphs [0027], [0033], [0035]; figures -----	1-20	X	US 6 238 249 B1 (Y. KUWAMURA) 29 May 2001 (2001-05-29) column 7, lines 6-21; figures 12-14 -----	1,6,7,12	A		13
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.												
X	US 2013/256389 A1 (D. NGAI ET AL) 3 October 2013 (2013-10-03) paragraphs [0027], [0033], [0035]; figures -----	1-20												
X	US 6 238 249 B1 (Y. KUWAMURA) 29 May 2001 (2001-05-29) column 7, lines 6-21; figures 12-14 -----	1,6,7,12												
A		13												
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Date of the actual completion of the international search		Date of mailing of the international search report												
26 July 2016		05/08/2016												
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Jeggy, Thierry												

INTERNATIONAL SEARCH REPORT

Information on patent family members

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