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(54) METHOD, SYSTEM, AND APPARATUS FOR TRANSFER OF DIES USING A DIE PLATE

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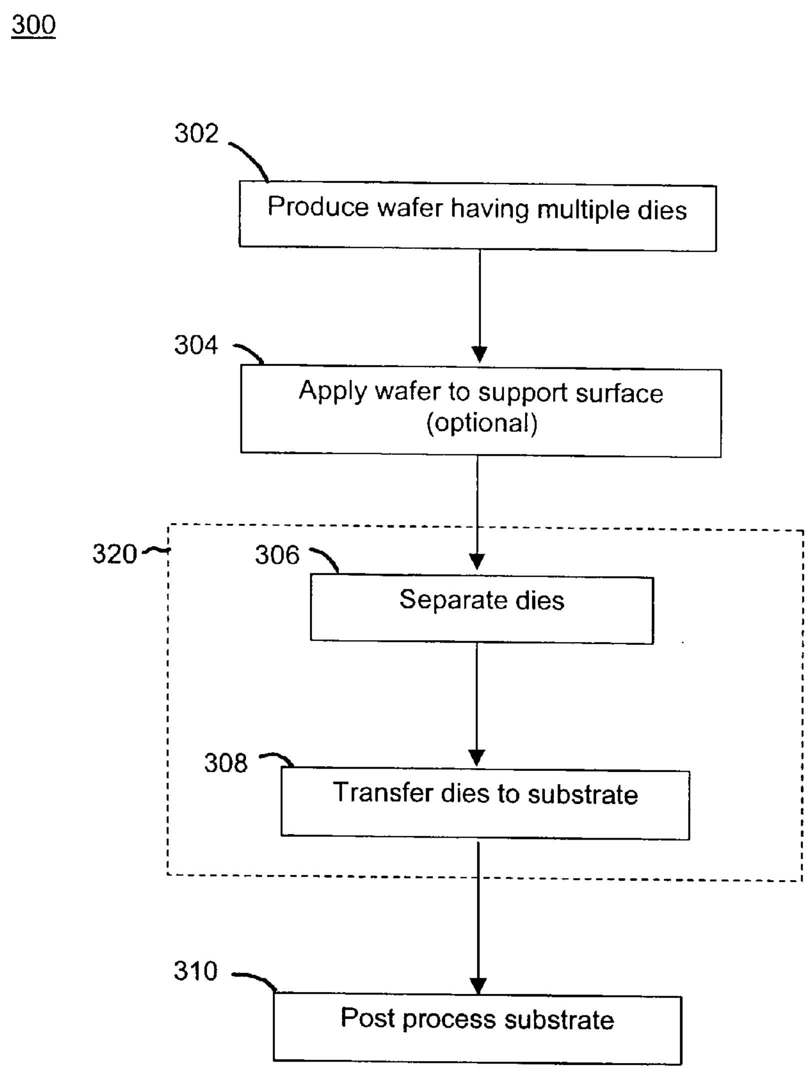
(57) ABSTRACT

A method, system, and apparatus for transfer of dies using a die plate is described herein. The die plate has a planar body. The body has a plurality of holes therethrough. A support structure and the die plate can be positioned to be closely adjacent to each other such that each die of a plurality of dies attached to the support structure adheres to a first surface of the die plate. The dies can subsequently be transferred from the die plate to one or more destination substrates or other surfaces, by a punching mechanism.



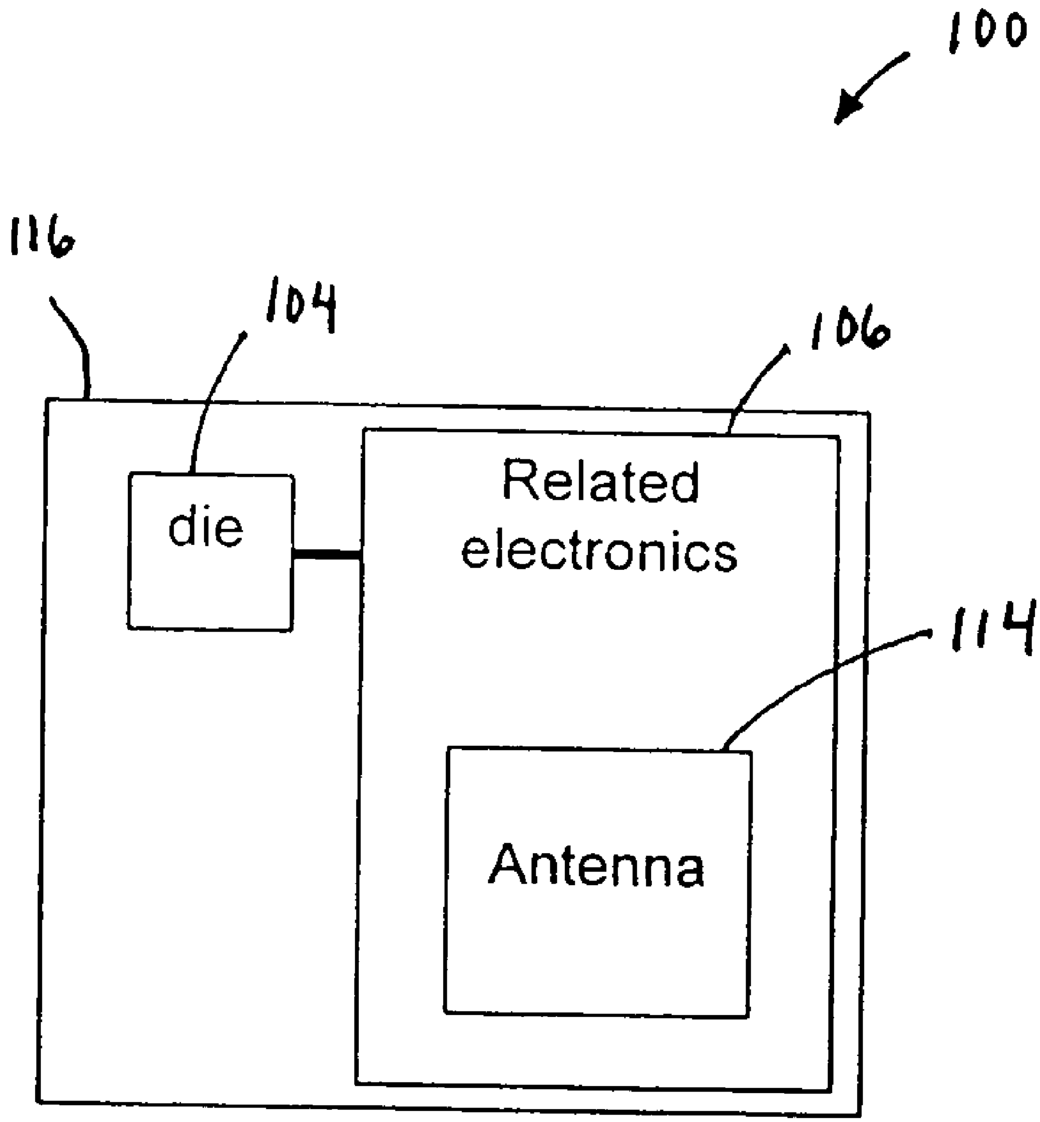


FIG. 1A

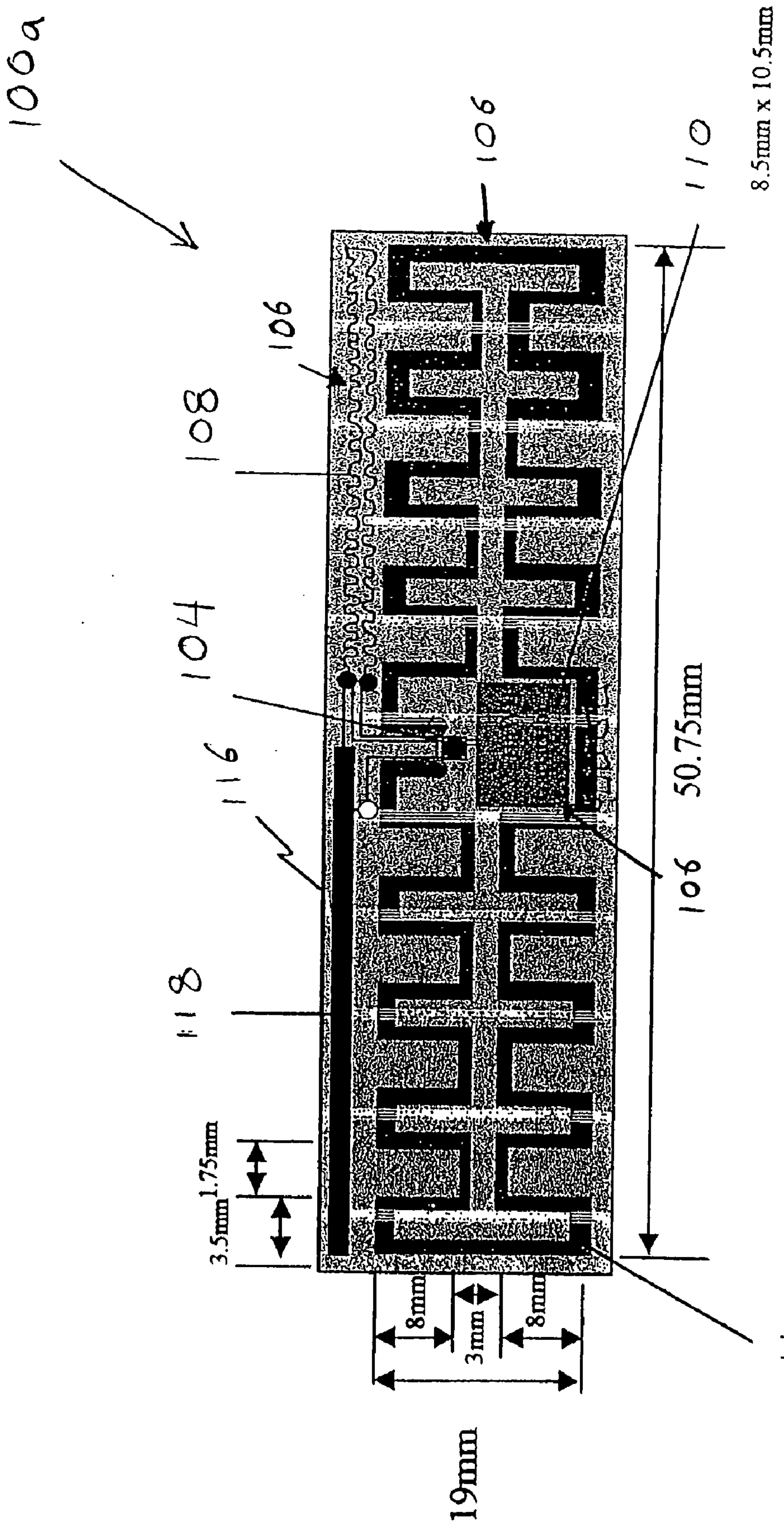

100a
106
108
104
116
118
110
106
114
8.5mm x 10.5mm
50.75mm
1.75mm
3.5mm
8mm
3mm
8mm
19mm

FIG. 1B

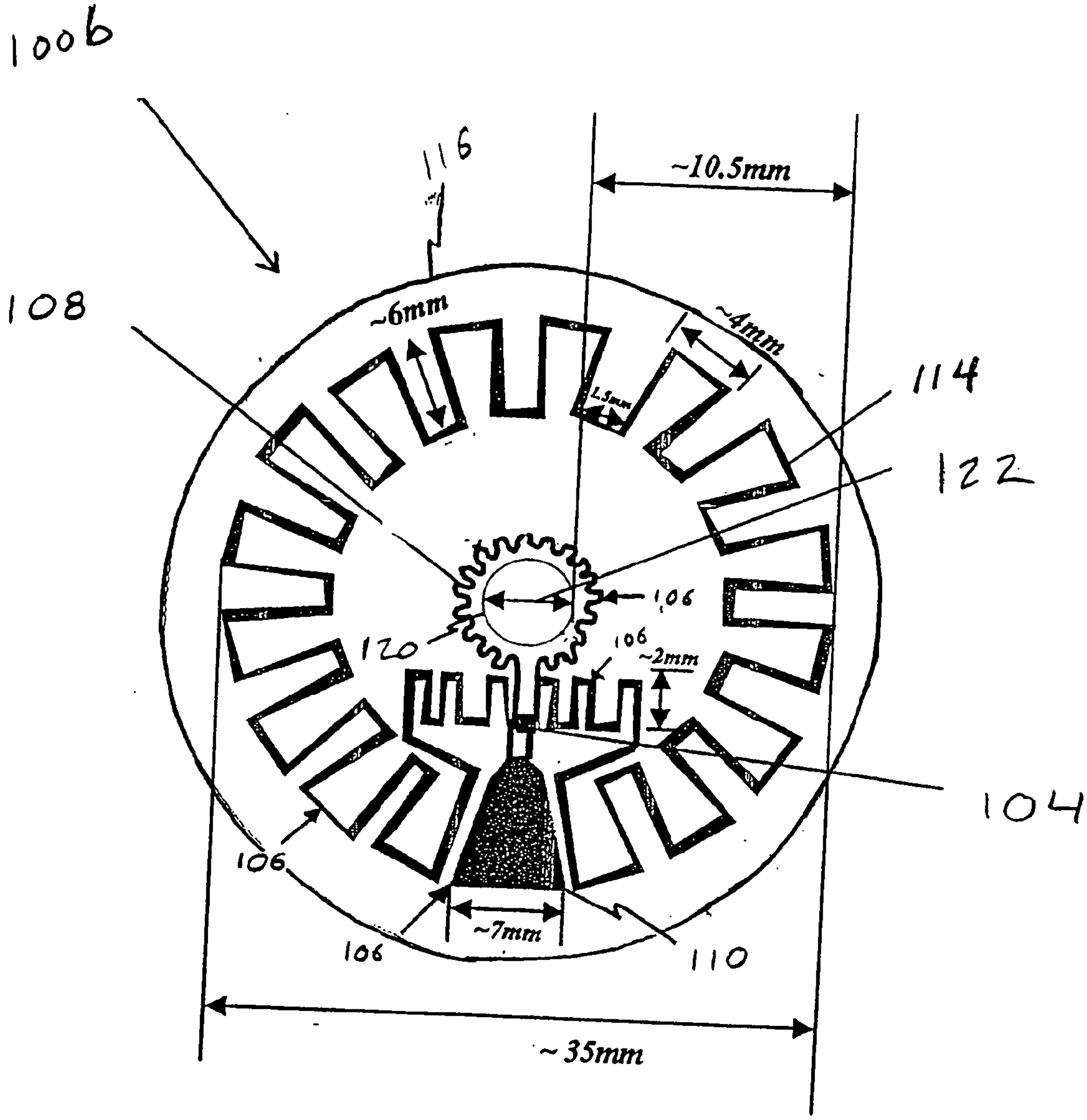

100b
116
~10.5mm
108
~6mm
~4mm
114
1.5mm
122
106
120
106
~2mm
104
106
106
~7mm
110
~35mm

FIG. 1C

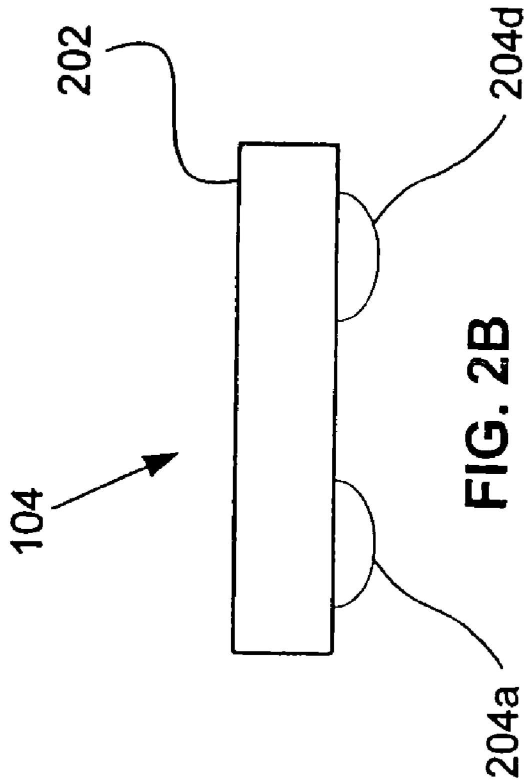


FIG. 2B

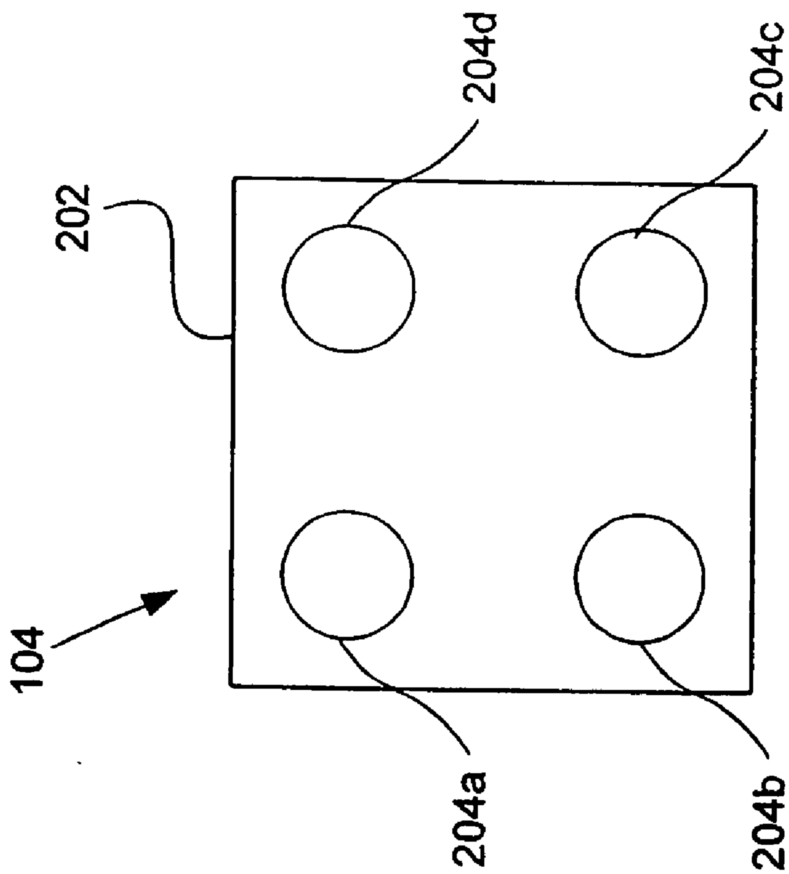


FIG. 2A

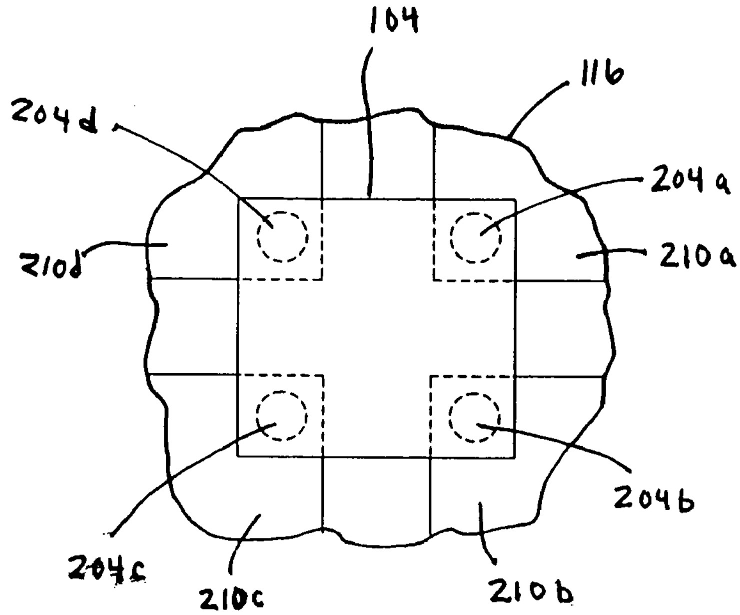

104
116
204d
204a
210d
210a
204b
204c
210c
210b

FIG. 2C

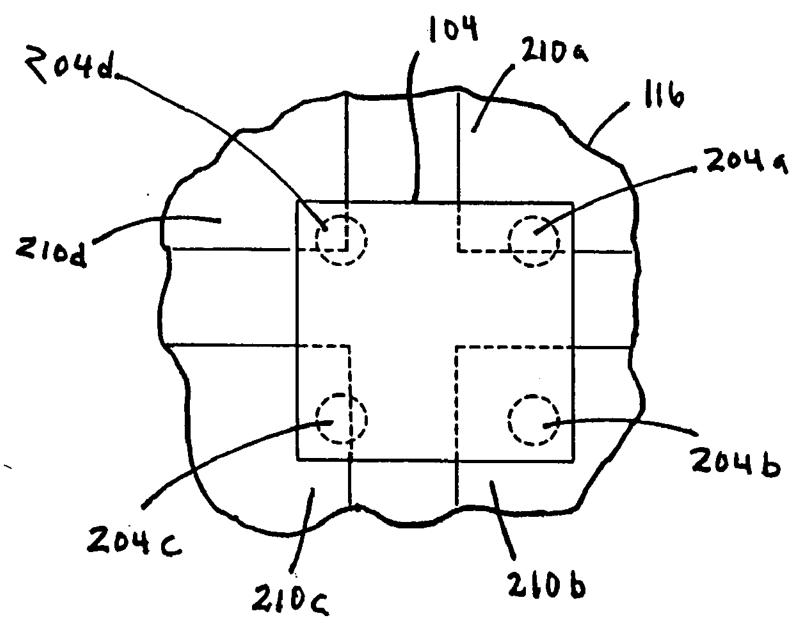

104
210a
204d
116
204a
210d
204b
204c
210c
210b

FIG. 2D

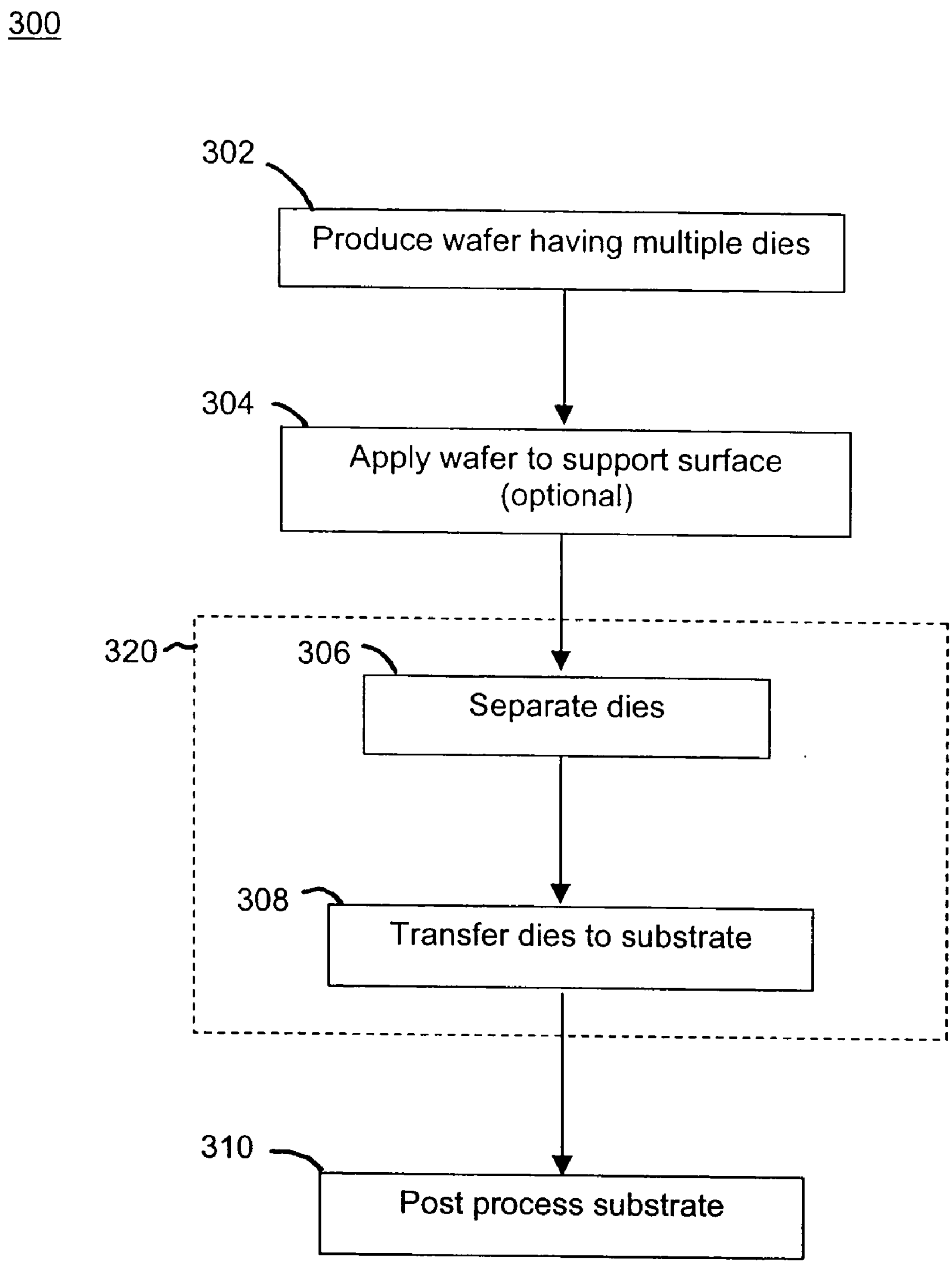

300
302
Produce wafer having multiple dies
304
Apply wafer to support surface (optional)
320
306
Separate dies
308
Transfer dies to substrate
310
Post process substrate

FIG. 3

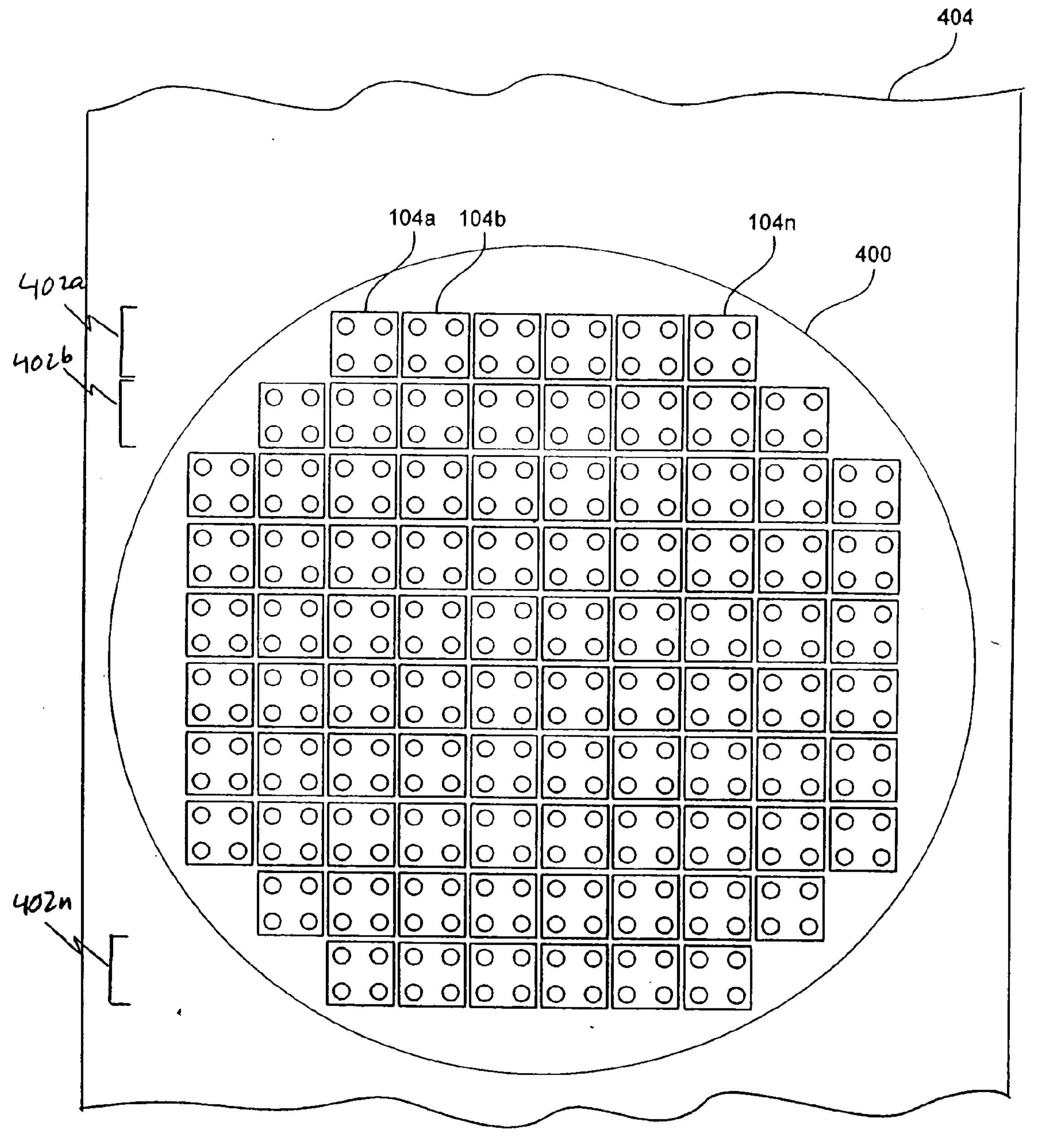


FIG. 4A

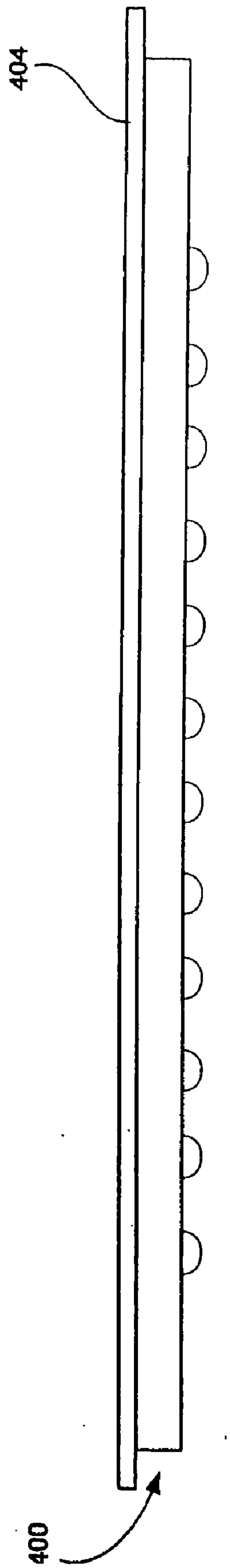


FIG. 4B

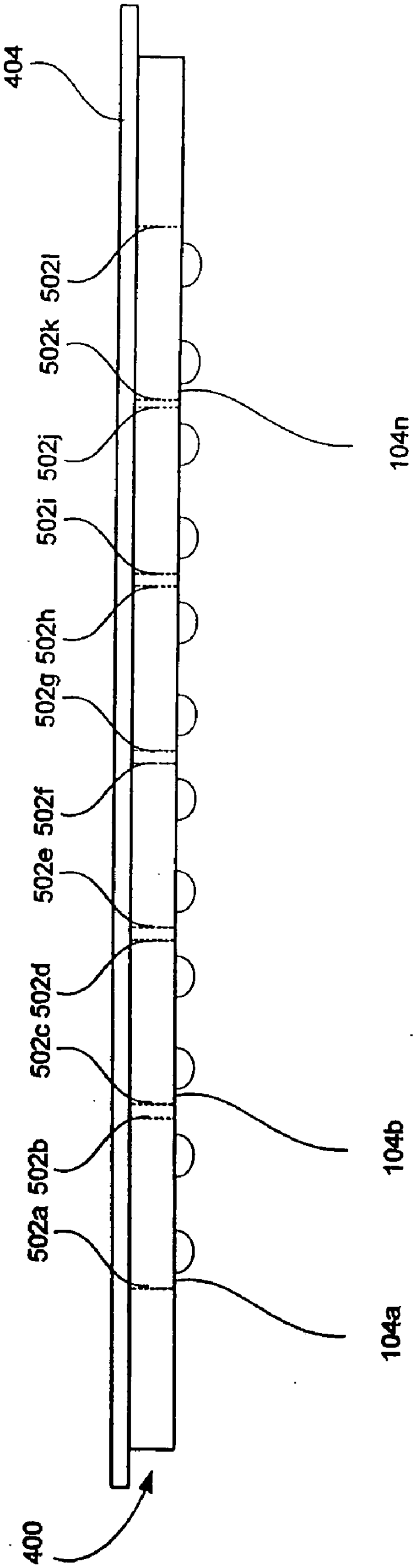

404
502l
502k
502j
502i
502h
502g
502f
502e
502d
502c
502b
502a
104n
104b
104a
400

FIG. 5

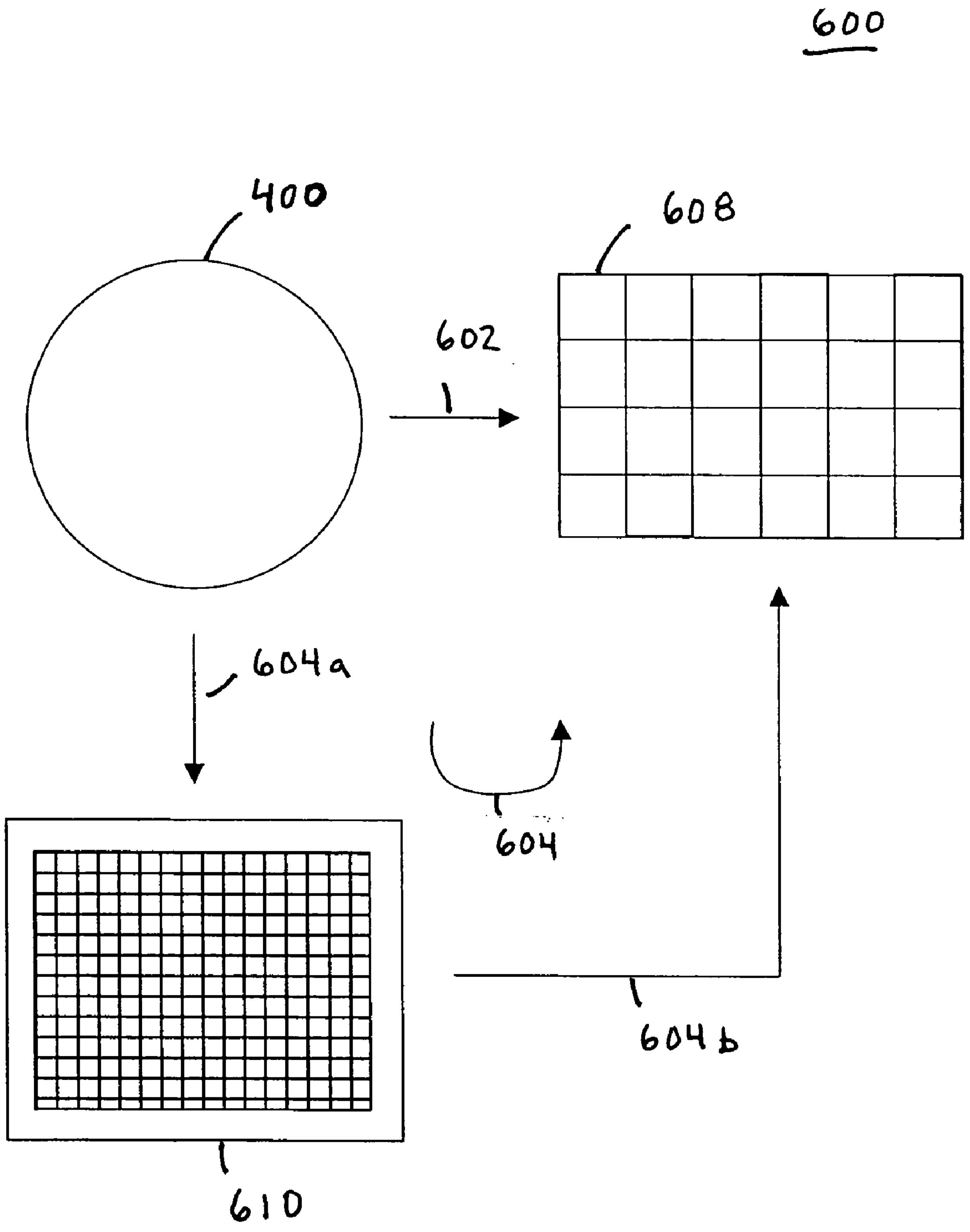


FIG. 6

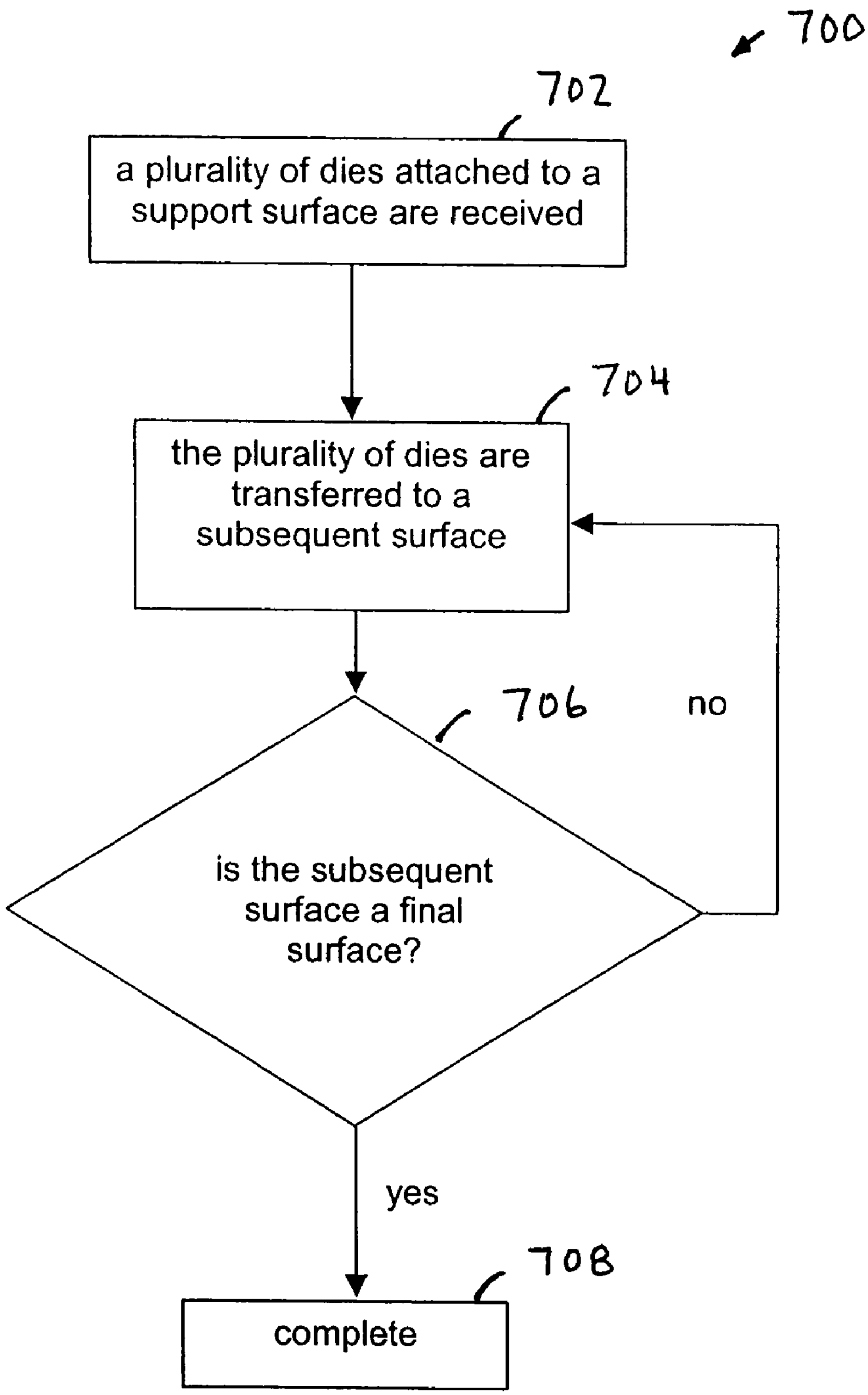

700
702
a plurality of dies attached to a support surface are received
704
the plurality of dies are transferred to a subsequent surface
706
no
is the subsequent surface a final surface?
yes
708
complete

FIG. 7

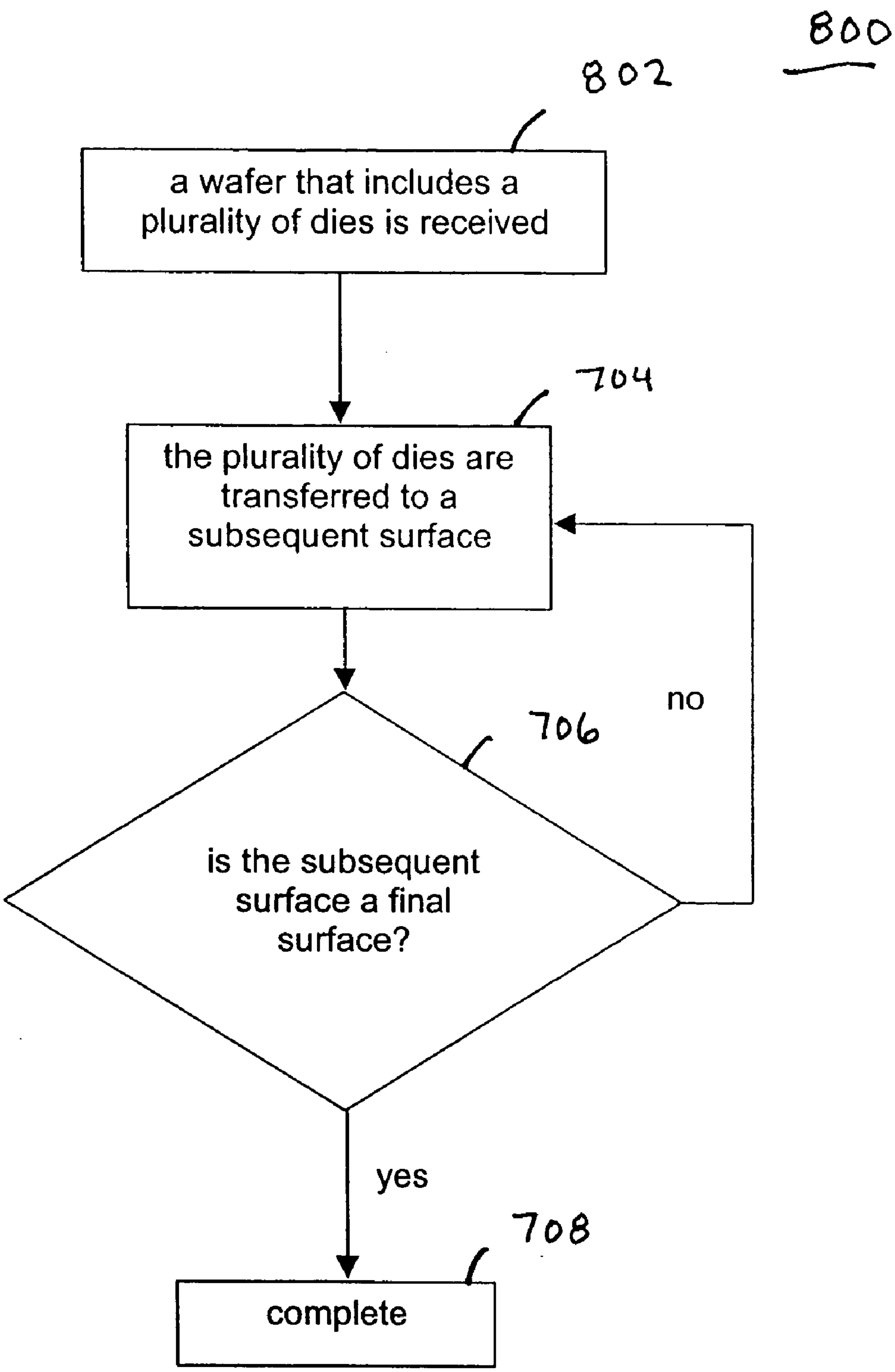

800
802
a wafer that includes a plurality of dies is received
704
the plurality of dies are transferred to a subsequent surface
706
no
is the subsequent surface a final surface?
yes
708
complete

FIG. 8

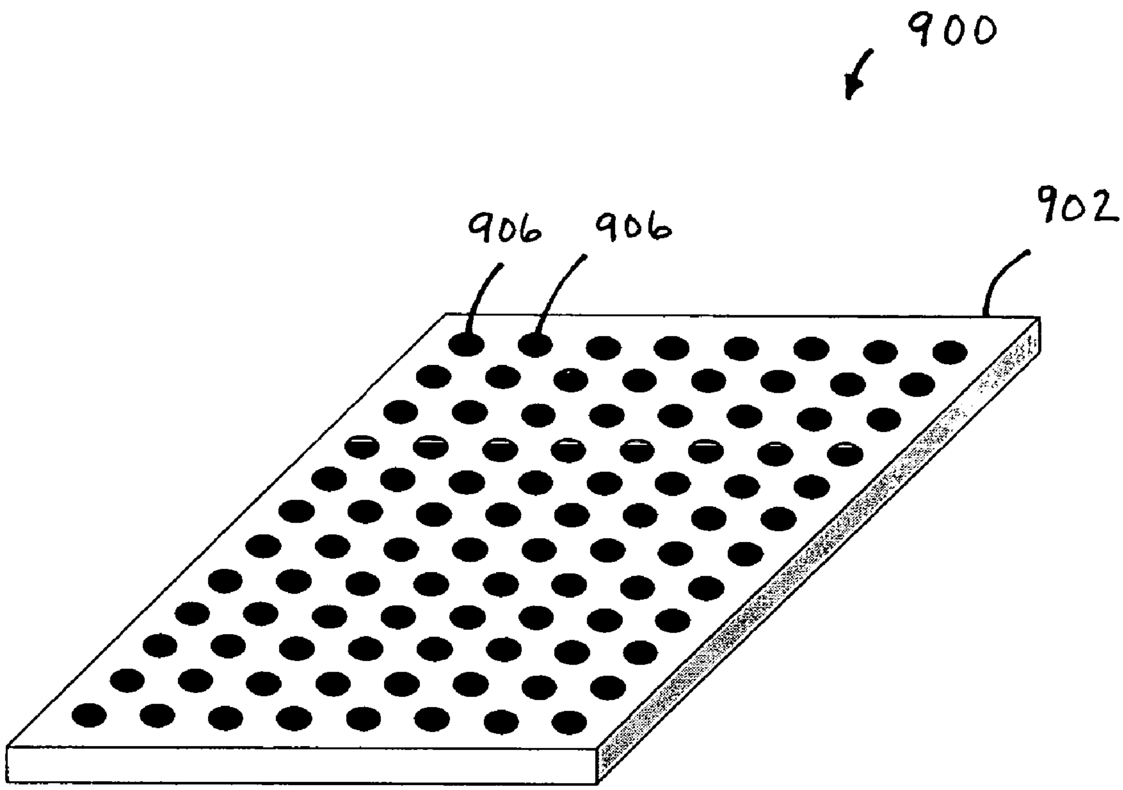


FIG. 9

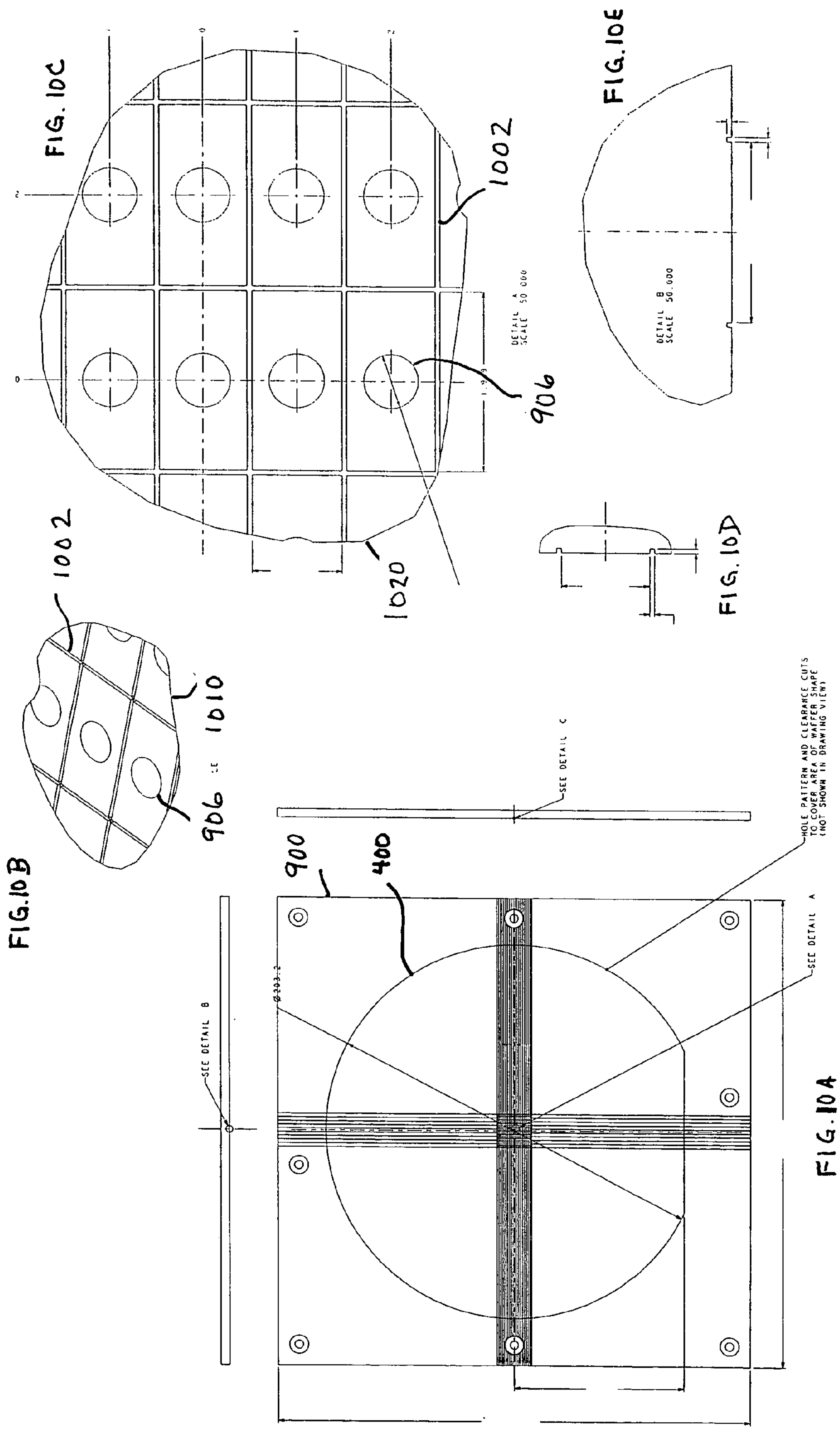


FIG. 10C
1002
906
1020
DETAIL A
DETAIL B
SCALE 50.000
FIG. 10E
FIG. 10D
FIG. 10B
1002
1010
906
SEE DETAIL C
HOLE PATTERN AND CLEARANCE CUTS TO COVER AREA OF WAFFER SHAPE (NOT SHOWN IN DRAWING VIEW)
900
400
SEE DETAIL B
SEE DETAIL A
FIG. 10A

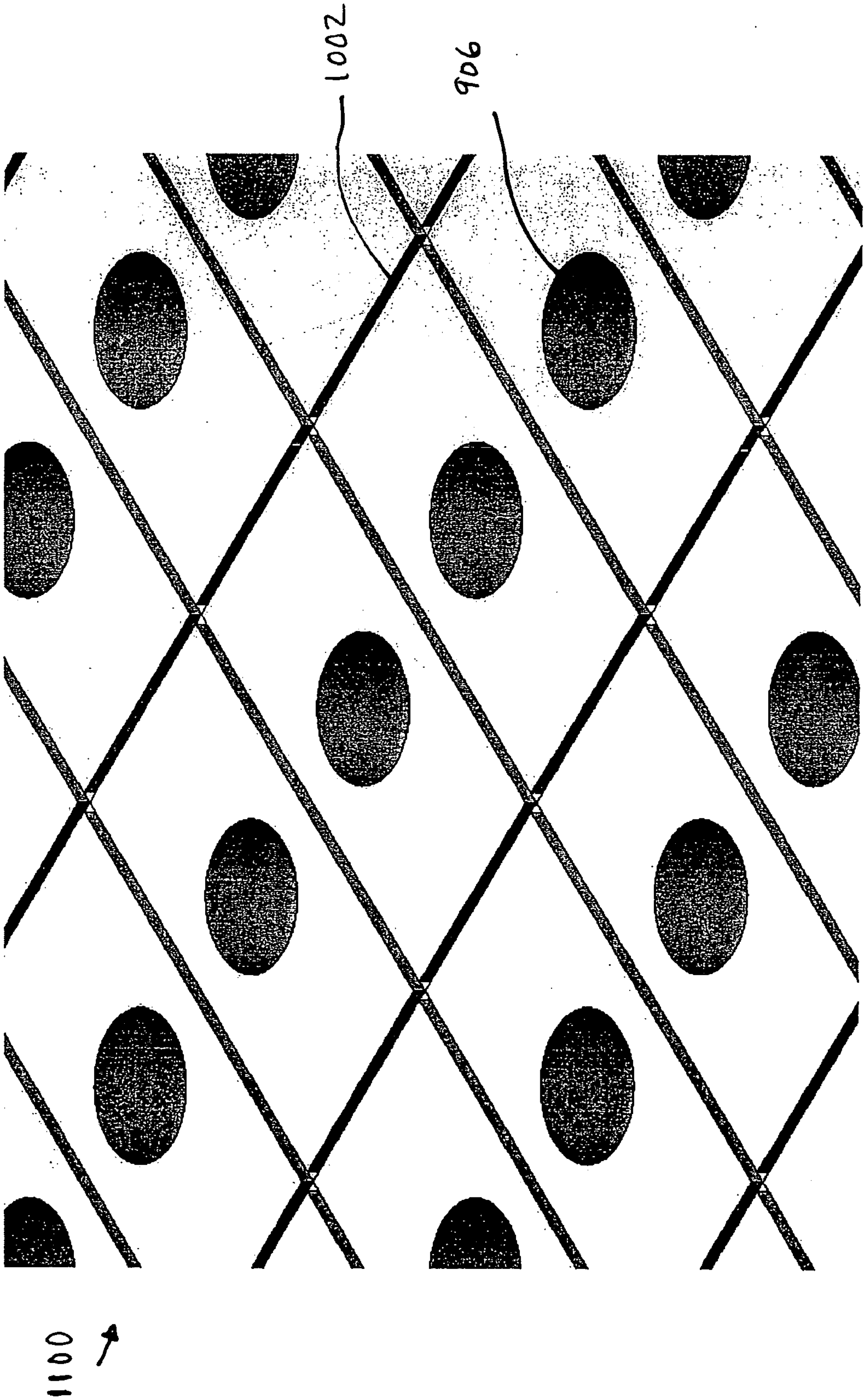


FIG. 11

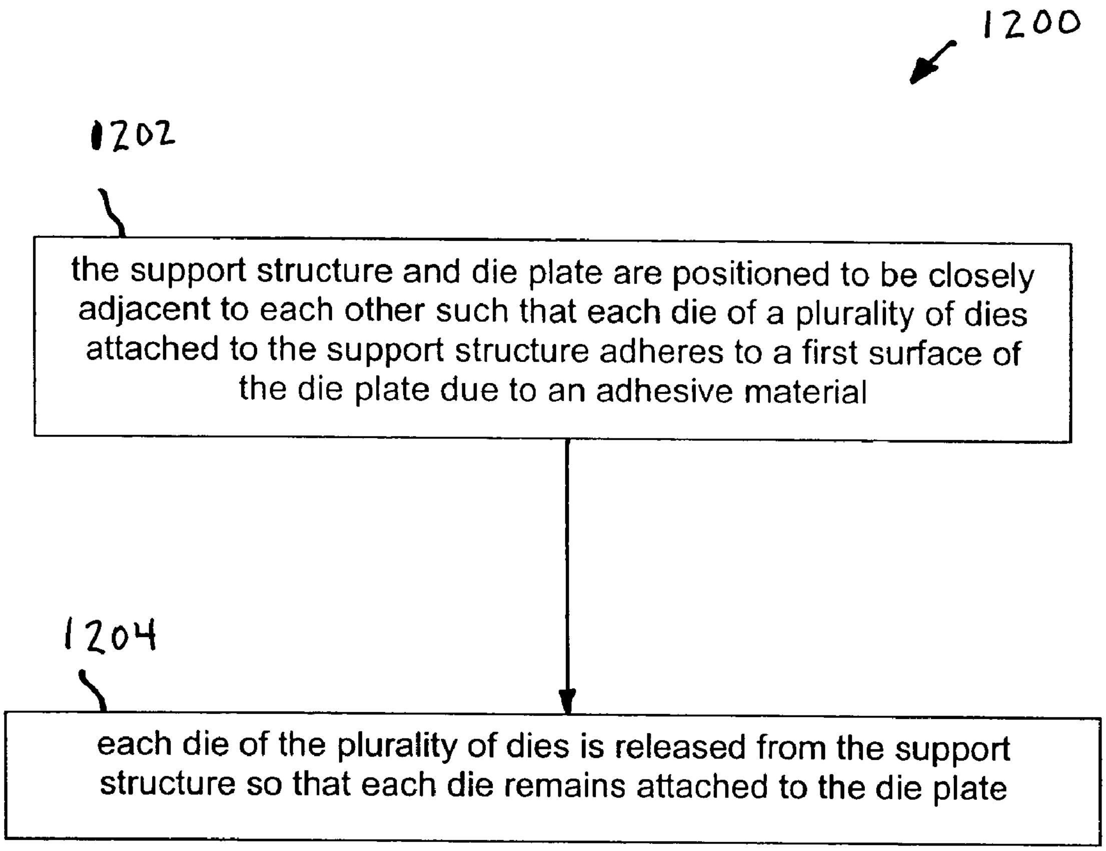

1200
1202
the support structure and die plate are positioned to be closely adjacent to each other such that each die of a plurality of dies attached to the support structure adheres to a first surface of the die plate due to an adhesive material
1204
each die of the plurality of dies is released from the support structure so that each die remains attached to the die plate

FIG. 12

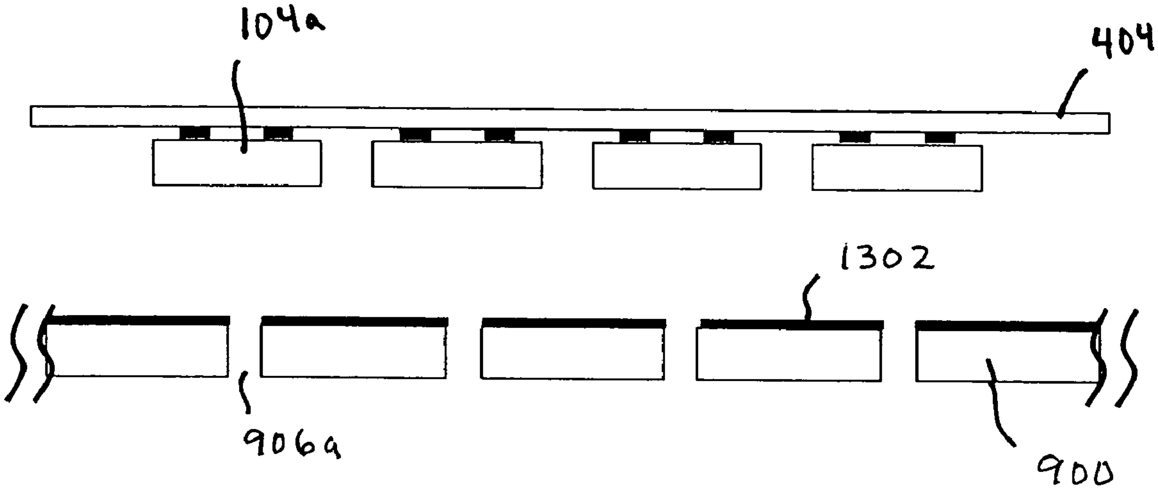


FIG. 13

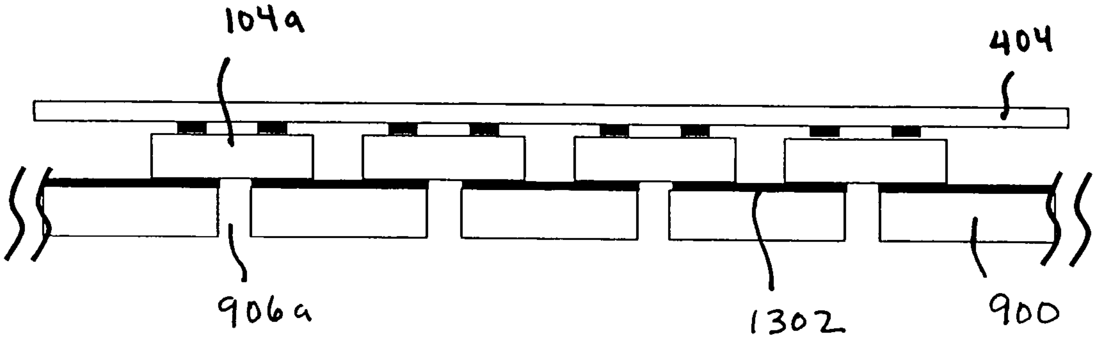


FIG. 14

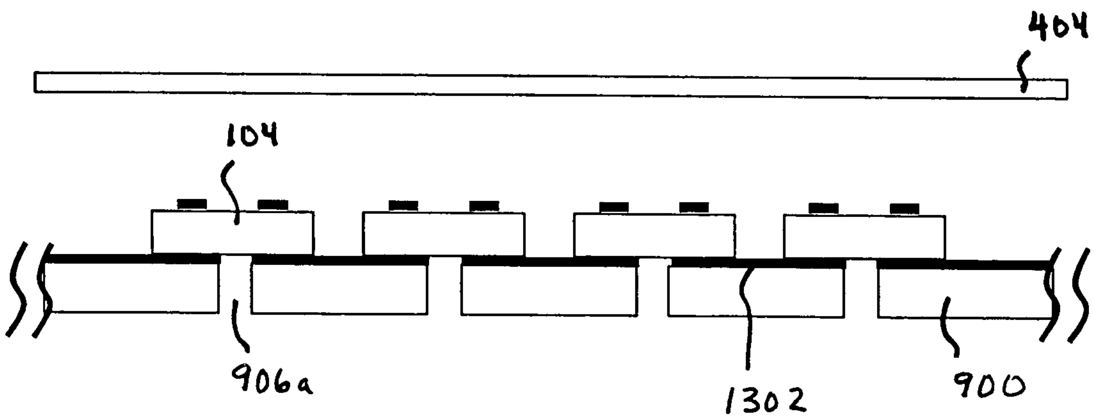


FIG. 15

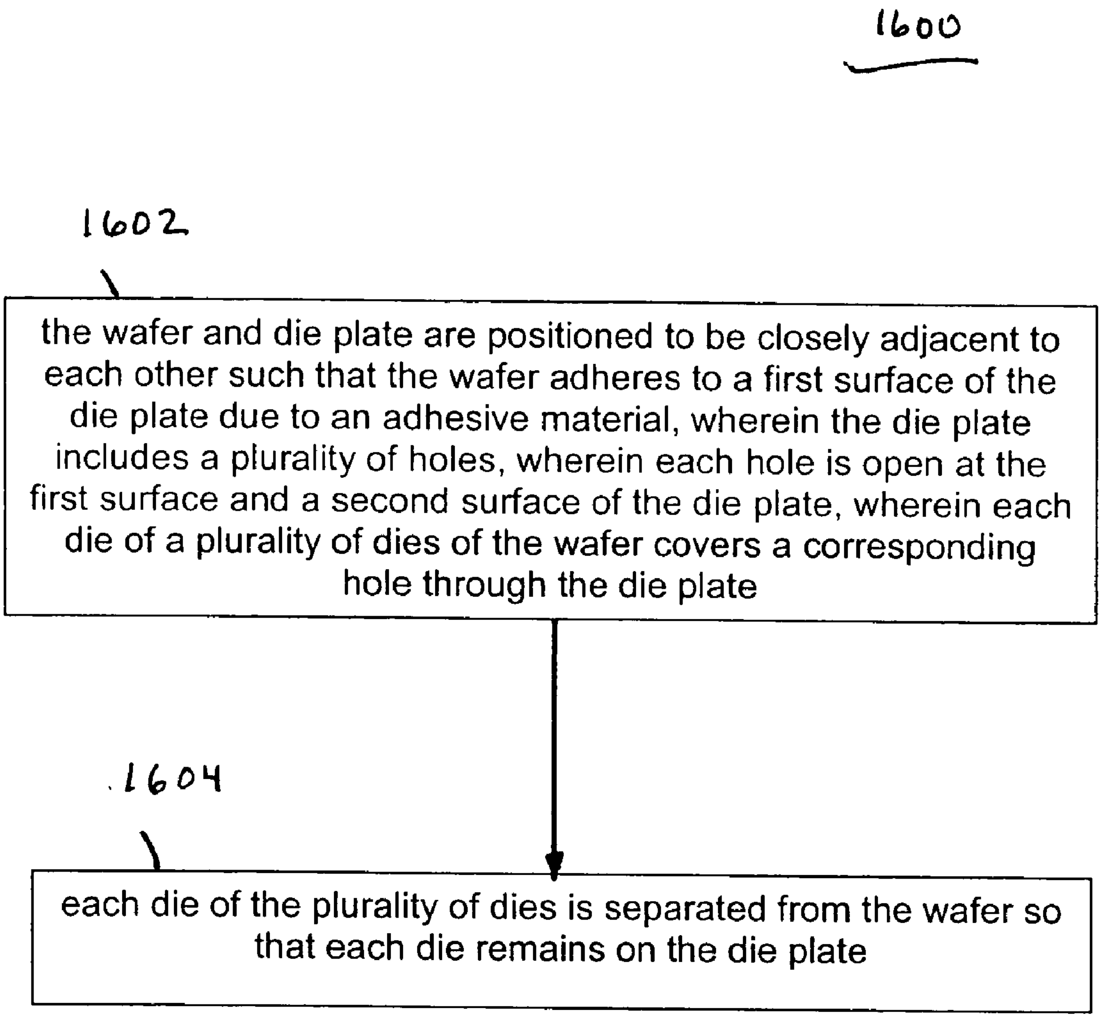

1600
1602
the wafer and die plate are positioned to be closely adjacent to each other such that the wafer adheres to a first surface of the die plate due to an adhesive material, wherein the die plate includes a plurality of holes, wherein each hole is open at the first surface and a second surface of the die plate, wherein each die of a plurality of dies of the wafer covers a corresponding hole through the die plate
1604
each die of the plurality of dies is separated from the wafer so that each die remains on the die plate

FIG. 16

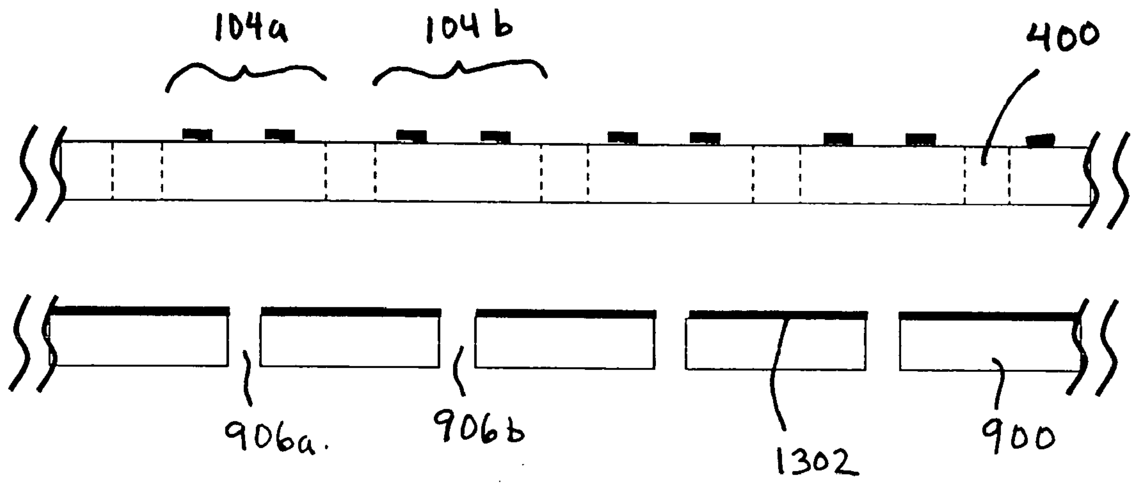


FIG. 17

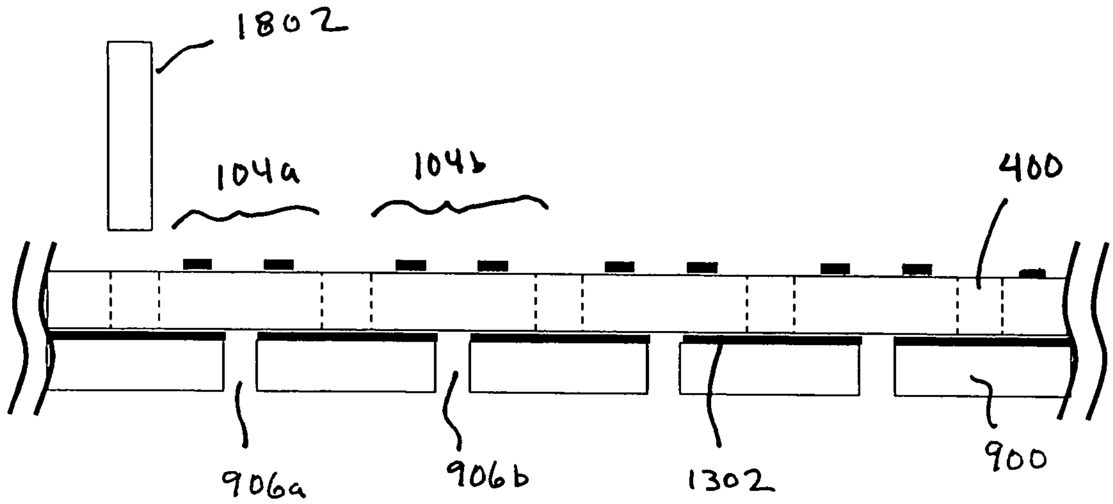

1802
104a
104b
400
906a
906b
1302
900

FIG. 18

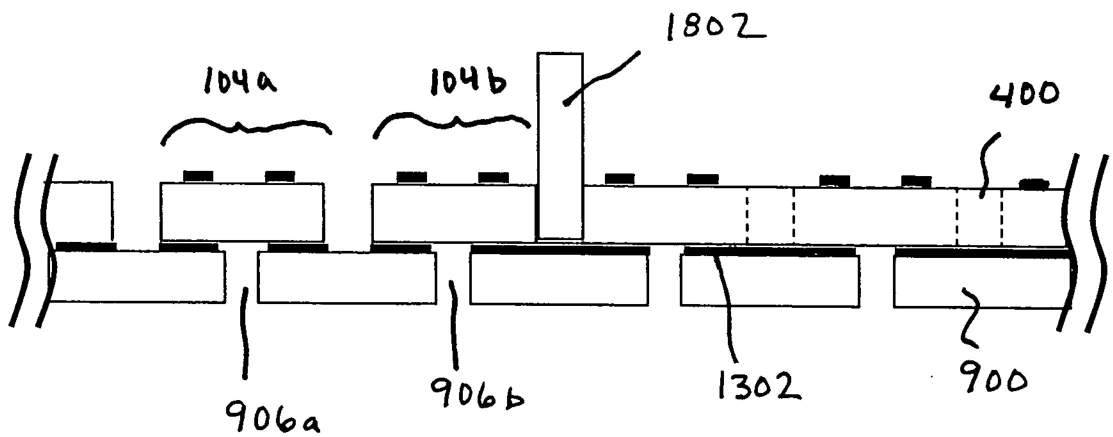

1802
104a
104b
400
906a
906b
1302
900

FIG. 19

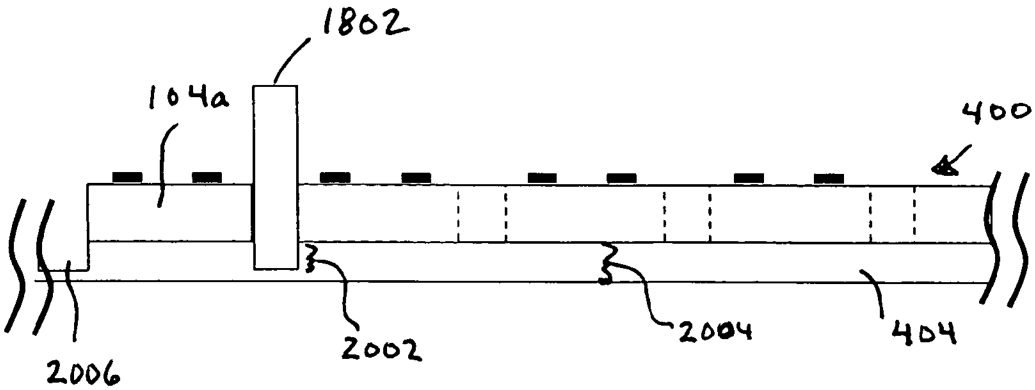

1802
104a
400
2006
2002
2004
404

FIG. 20

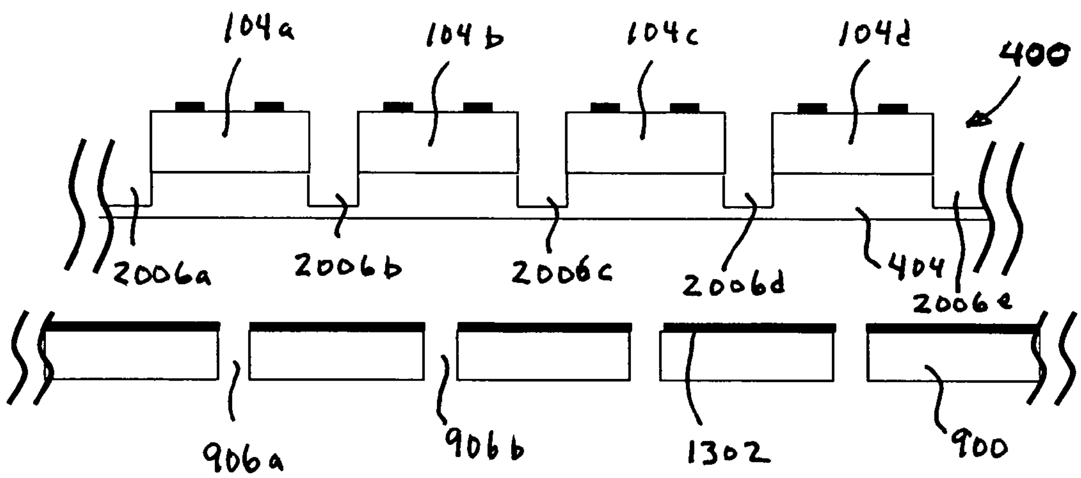

104a
104b
104c
104d
400
2006a
2006b
2006c
2006d
404
2006e
906a
906b
1302
900

FIG. 21

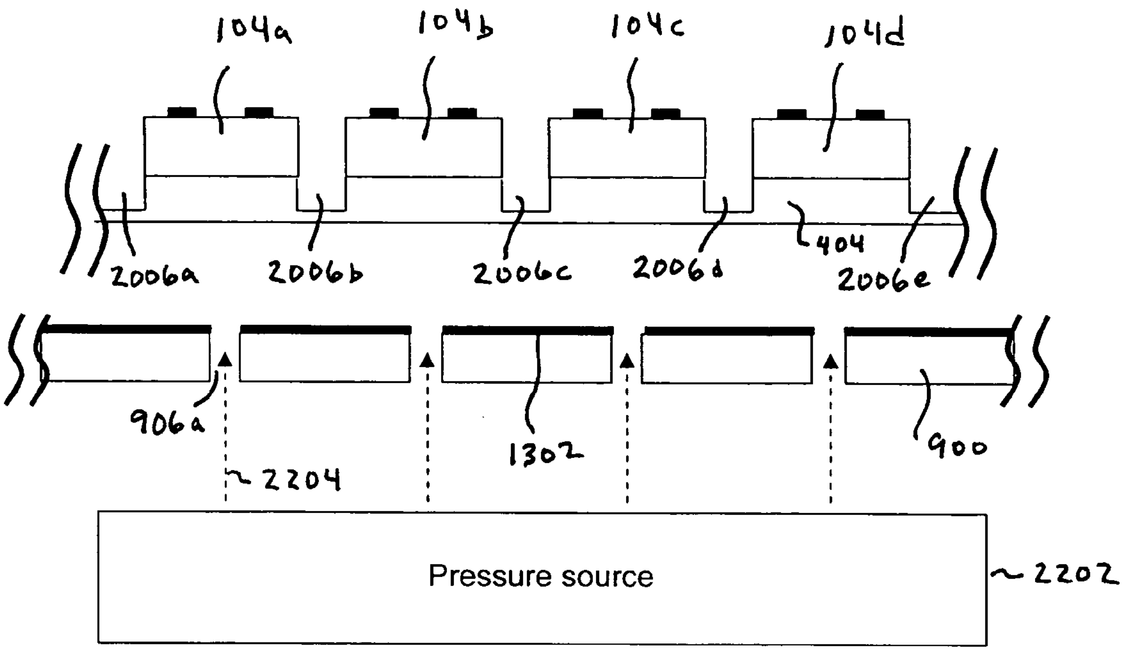

104a
104b
104c
104d
2006a
2006b
2006c
2006d
404
2006e
906a
1302
900
2204
Pressure source
2202

FIG. 22

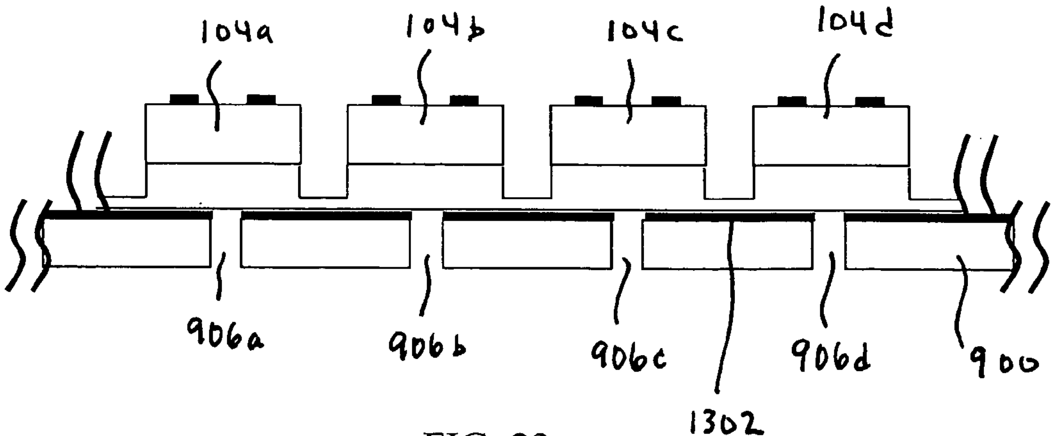

104a
104b
104c
104d
906a
906b
906c
906d
900
1302

FIG. 23

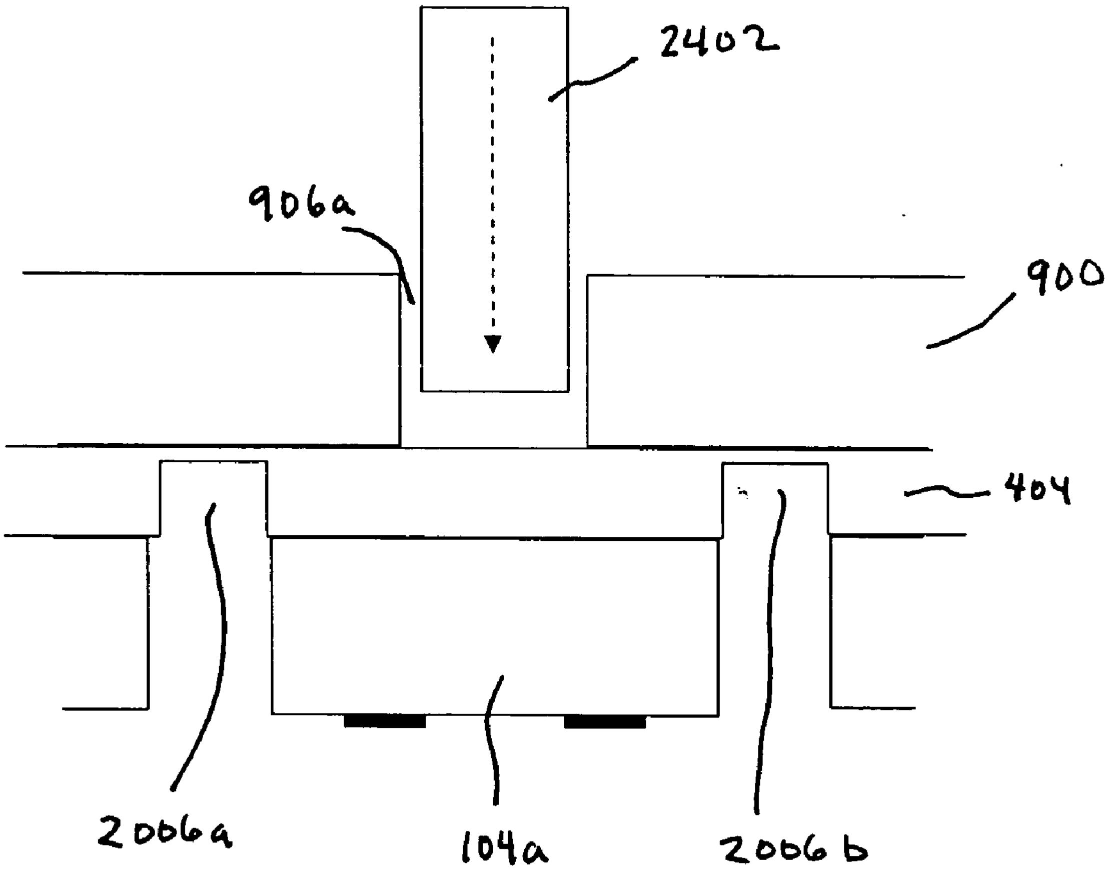


FIG. 24

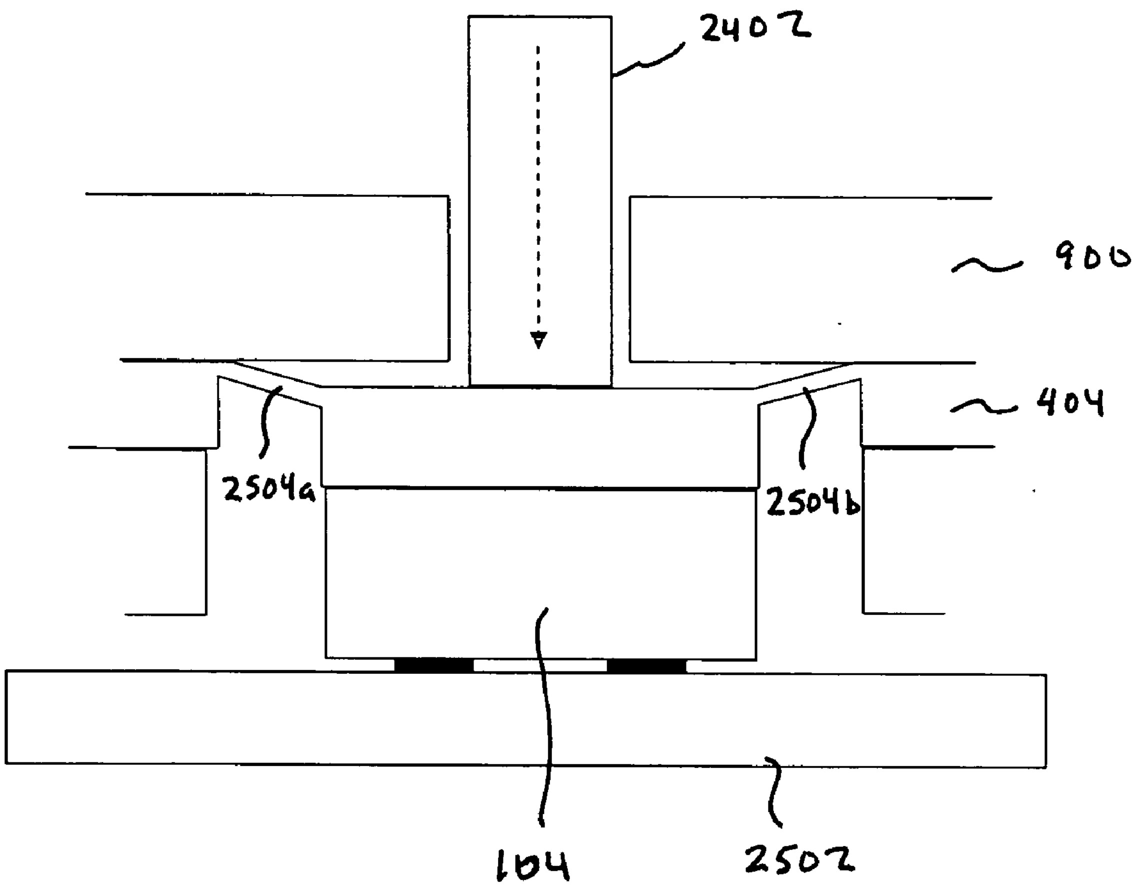


FIG. 25

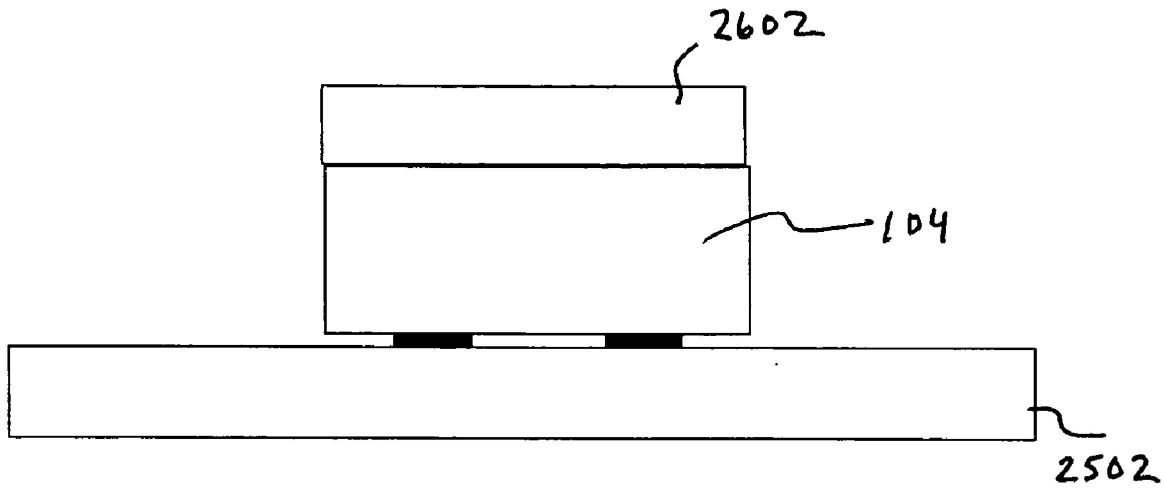


FIG. 26

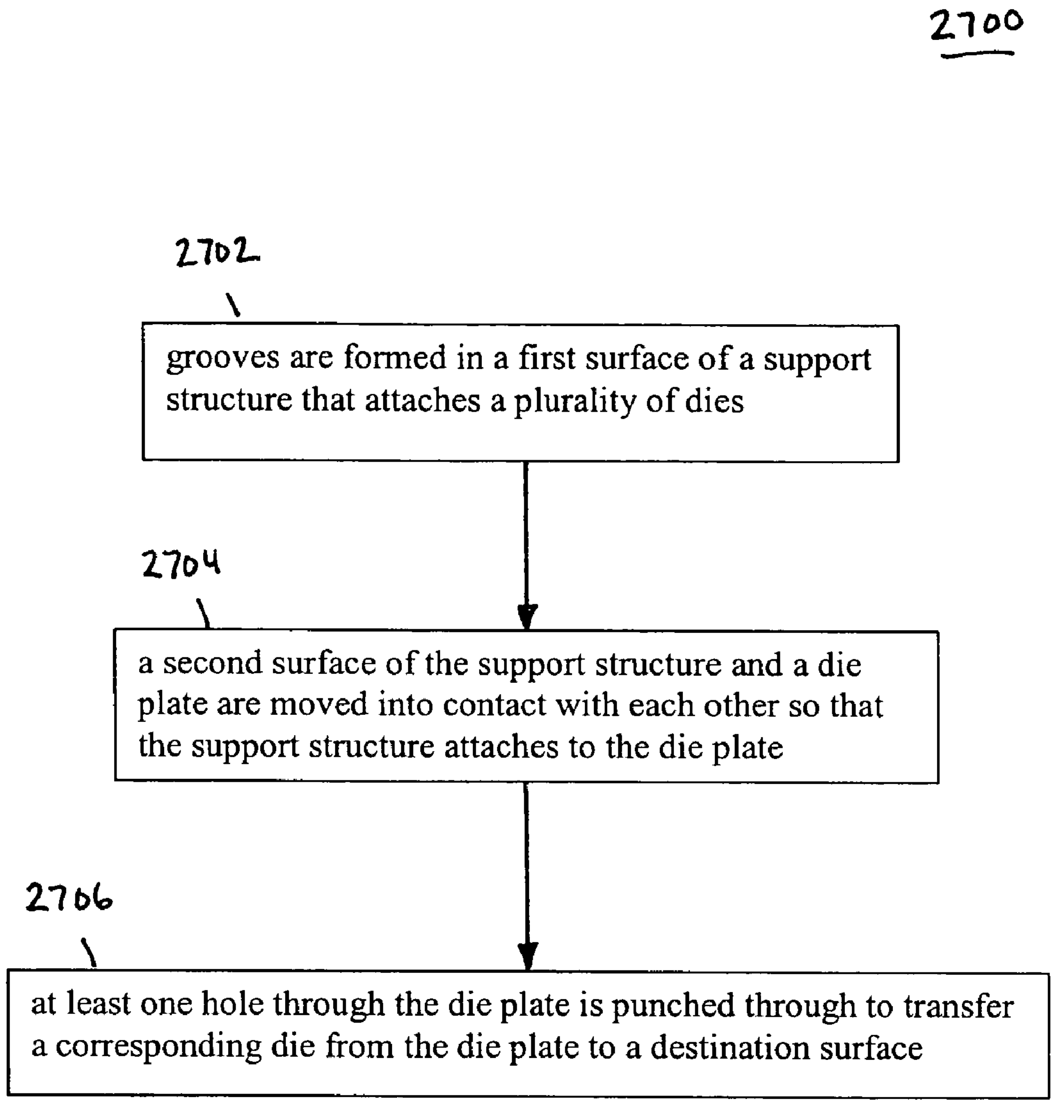

2700
2702
grooves are formed in a first surface of a support structure that attaches a plurality of dies
2704
a second surface of the support structure and a die plate are moved into contact with each other so that the support structure attaches to the die plate
2706
at least one hole through the die plate is punched through to transfer a corresponding die from the die plate to a destination surface

FIG. 27

METHOD, SYSTEM, AND APPARATUS FOR TRANSFER OF DIES USING A DIE PLATE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/477,735, filed Jun. 12, 2003 (Atty. Dkt. No. 1689.0350000), which is herein incorporated by reference in its entirety.

[0002] The following applications of common assignee are related to the present application, have the same filing date as the present application, and are herein incorporated by reference in their entireties:

[0003] "Method And Apparatus For Expanding A Semiconductor Wafer," U.S. Ser. No. ______ (Atty. Dkt. No. 1689.0520000);

[0004] "Method, System, And Apparatus For Authenticating Devices During Assembly," U.S. Ser. No. ______ (Atty. Dkt. No. 1689.0530000);

[0005] "Method, System, And Apparatus For Transfer Of Dies Using A Die Plate Having Die Cavities," U.S. Ser. No. ______ (Atty. Dkt. No. 1689.0540000);

[0006] "Method, System, And Apparatus For Transfer Of Dies Using A Pin Plate," U.S. Ser. No. ______ (Atty. Dkt. No. 1689.0560000);

[0007] "Method, System, And Apparatus For High Volume Transfer Of Dies," U.S. Ser. No. ______ (Atty. Dkt. No. 1689.0580000); and

[0008] "Method, System, And Apparatus For High Volume Assembly Of Compact Discs And Digital Video Discs Incorporating Radio Frequency Identification Tag Technology," U.S. Ser. No. ______ (Atty. Dkt. No. 1689.0590000).

[0009] The following applications of common assignee are related to the present application, and are herein incorporated by reference in their entireties:

[0010] "Method and Apparatus for High Volume Assembly of Radio Frequency Identification Tags," U.S. Provisional App. No. 60/400,101, filed Aug. 2, 2002 (Atty. Dkt. No. 1689.0110000);

[0011] "Method and Apparatus for High Volume Assembly of Radio Frequency Identification Tags," Ser. No. 10/322,467, filed Dec. 19, 2002 (Atty. Dkt. No. 1689.0110001);

[0012] "Multi-Barrel Die Transfer Apparatus and Method for Transferring Dies Therewith," Ser. No. 10/322,718, filed Dec. 19, 2002 (Atty. Dkt. No. 1689.0110002);

[0013] "Die Frame Apparatus and Method of Transferring Dies Therewith," Ser. No. 10/322,701, filed Dec. 19, 2002 (Atty. Dkt. No. 1689.0110003);

[0014] "System and Method of Transferring Dies Using an Adhesive Surface," Ser. No. 10/322,702, filed Dec. 19, 2002 (Atty. Dkt. No. 1689.0110004); and

[0015] "Method and System for Forming a Die Frame and for Transferring Dies Therewith," Ser. No. 10/429,803, filed May 6, 2003 (Atty. Dkt. No. 1689.0110005).

BACKGROUND OF THE INVENTION

[0016] 1. Field of the Invention

[0017] The present invention relates generally to the assembly of electronic devices. More particularly, the present invention relates to the transfer of dies from wafers to substrates, including substrates of radio frequency identification (RFID) tags.

[0018] 2. Related Art

[0019] Pick and place techniques are often used to assemble electronic devices. Such techniques involve a manipulator, such as a robot arm, to remove integrated circuit (IC) dies from a wafer and place them into a die carrier. The dies are subsequently mounted onto a substrate with other electronic components, such as antennas, capacitors, resistors, and inductors to form an electronic device.

[0020] Pick and place techniques involve complex robotic components and control systems that handle only one die at a time. This has a drawback of limiting throughput volume. Furthermore, pick and place techniques have limited placement accuracy, and have a minimum die size requirement.

[0021] One type of electronic device that may be assembled using pick and place techniques is an RFID "tag." An RFID tag may be affixed to an item whose presence is to be detected and/or monitored. The presence of an RFID tag, and therefore the presence of the item to which the tag is affixed, may be checked and monitored by devices known as "readers."

[0022] As market demand increases for products such as RFID tags, and as die sizes shrink, high assembly throughput rates for very small die, and low production costs are crucial in providing commercially-viable products. Accordingly, what is needed is a method and apparatus for high volume assembly of electronic devices, such as RFID tags, that overcomes these limitations.

SUMMARY OF THE INVENTION

[0023] The present invention is directed to methods, systems, and apparatuses for producing one or more electronic devices, such as RFID tags, that each include a die having one or more electrically conductive contact pads that provide electrical connections to related electronics on a substrate.

[0024] According to the present invention, electronic devices are formed at much greater rates than conventionally possible. In one aspect, large quantities of dies can be transferred directly from a wafer to corresponding substrates of a web of substrates. In another aspect, large quantities of dies can be transferred from a support surface to corresponding substrates of a web of substrates. In another aspect, large quantities of dies can be transferred from a wafer or support surface to an intermediate surface, such as a die plate. The die plate may have cells formed in a surface thereof in which the dies reside. Otherwise, the dies can reside on a surface of the die plate. The dies of the die plate can then be transferred to corresponding substrates of a web of substrates.

[0025] In an aspect of the present invention, methods, systems, and apparatuses for transfer of dies using the die plate are described herein. The die plate has a planar body. The body has a plurality of holes therethrough.

[0026] In a further aspect, a support structure and the die plate can be positioned to be closely adjacent to each other such that each die of a plurality of dies attached to the support structure adheres to a first surface of the die plate. The dies can subsequently be transferred from the die plate to one or more destination substrates or other surfaces, by a punching or other mechanism.

[0027] In an aspect, a punch plate, punch roller or cylinder, or expandable material can be used to transfer dies from the die plate to substrates.

[0028] Large quantities of dies can be transferred. For example, 10s, 100s, 1000s, or more dies, or even all dies of a wafer, support surface, or die plate, can be simultaneously transferred to corresponding substrates of a web.

[0029] In one aspect, dies may be transferred between surfaces in a "pads up" orientation. When dies are transferred to a substrate in a "pads up" orientation, related electronics can be printed or otherwise formed to couple contact pads of the die to related electronics of the tag substrate.

[0030] In an alternative aspect, the dies may be transferred between surfaces in a "pads down" orientation. When dies are transferred to a substrate in a "pads down" orientation, related electronics can be pre-printed or otherwise pre-deposited on the tag substrates.

[0031] These and other advantages and features will become readily apparent in view of the following detailed description of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS/FIGURES

[0032] The accompanying drawings, which are incorporated herein and form a part of the specification, illustrate the present invention and, together with the description, further serve to explain the principles of the invention and to enable a person skilled in the pertinent art to make and use the invention.

[0033] **FIG. 1A** shows a block diagram of an exemplary RFID tag, according to an embodiment of the present invention.

[0034] **FIGS. 1B and 1C** show detailed views of exemplary RFID tags, according to embodiments of the present invention.

[0035] **FIGS. 2A and 2B** show plan and side views of an exemplary die, respectively.

[0036] **FIGS. 2C and 2D** show portions of a substrate with a die attached thereto, according to example embodiments of the present invention.

[0037] **FIG. 3** is a flowchart illustrating a tag assembly process, according to embodiments of the present invention.

[0038] **FIGS. 4A and 4B** are plan and side views of a wafer having multiple dies affixed to a support surface, respectively.

[0039] **FIG. 5** is a view of a wafer having separated dies affixed to a support surface.

[0040] **FIG. 6** shows a system diagram illustrating example options for transfer of dies from wafers to substrates, according to embodiments of the present invention.

[0041] **FIGS. 7 and 8** show flowcharts providing steps for transferring dies from a first surface to a second surface, according to embodiments of the present invention.

[0042] **FIG. 9** shows a perspective view of an example die plate, according to an example embodiment of the present invention.

[0043] **FIGS. 10A-10E** show multiple schematic views of an example die plate, according to an embodiment of the present invention.

[0044] **FIG. 11** shows a perspective view of a portion of a surface of a die plate, according to an embodiment of the present invention.

[0045] **FIG. 12** shows a flowchart providing example steps for transferring dies from a support structure to a die plate, according to embodiments of the present invention.

[0046] **FIGS. 13-15** show example implementations of the steps of the flowchart of **FIG. 12**, according to embodiments of the present invention.

[0047] **FIG. 16** shows a flowchart providing example steps for transferring dies from a wafer to a die plate, according to embodiments of the present invention.

[0048] **FIGS. 17-19** show example implementations of the steps of the flowchart of **FIG. 16**, according to embodiments of the present invention.

[0049] **FIGS. 20-26** show various views of a transfer of dies to a die plate, and subsequently to one or more substrates, according to embodiments of the present invention.

[0050] **FIG. 27** shows a flowchart providing steps for transferring dies, according to embodiments of the present invention.

[0051] The present invention will now be described with reference to the accompanying drawings. In the drawings, like reference numbers generally indicate identical, functionally similar, and/or structurally similar elements. The drawing in which an element first appears is indicated by the leftmost digit(s) in the reference number.

DETAILED DESCRIPTION OF THE INVENTION

[0052] The present invention provides improved processes and systems for assembling electronic devices, including RFID tags. The present invention provides improvements over current processes. Conventional techniques include vision-based systems that pick and place dies one at a time onto substrates. The present invention can transfer multiple dies simultaneously. Vision-based systems are limited as far as the size of dies that may be handled, such as being limited to dies larger than 600 microns square. The present invention is applicable to dies 100 microns square and even smaller. Furthermore, yield is poor in conventional systems, where two or more dies may be accidentally picked up at a time, causing losses of additional dies. The present invention allows for improved yield values.

[0053] The present invention provides an advantage of simplicity. Conventional die transfer tape mechanisms may be used by the present invention. Furthermore, much higher fabrication rates are possible. Current techniques process 5-8 thousand units per hour. The present invention can provide improvements in these rates by a factor of N. For example, embodiments of the present invention can process dies 5 times as fast as conventional techniques, at 100 times as fast as conventional techniques, and at even faster rates. Furthermore, because the present invention allows for flip-chip die attachment techniques, wire bonds are not necessary.

[0054] Elements of the embodiments described herein may be combined in any manner. Example RFID tags are described in the section below. Assembly embodiments for RFID tags are described in the next section. Example applications for tags and tag assembly techniques are then described, followed by a description of example substrate webs and antenna layouts.

[0055] 1.0 RFID Tag

[0056] The present invention is directed to techniques for producing electronic devices, such as RFID tags. For illustrative purposes, the description herein primarily relates to the production of RFID tags. However, the description is also adaptable to the production of further electronic device types, as would be understood by persons skilled in the relevant art(s) from the teachings herein.

[0057] **FIG. 1A** shows a block diagram of an exemplary RFID tag **100**, according to an embodiment of the present invention. As shown in **FIG. 1A**, RFID tag **100** includes a die **104** and related electronics **106** located on a tag substrate **116**. Related electronics **106** includes an antenna **114** in the present example. **FIGS. 1B and 1C** show detailed views of exemplary RFID tags **100**, indicated as RFID tags **100***a* and **10***b*. As shown in **FIGS. 1B and 1C**, die **104** can be mounted onto antenna **114** of related electronics **106**. As is further described elsewhere herein, die **104** may be mounted in either a pads up or pads down orientation.

[0058] RFID tag **100** may be located in an area having a large number, population, or pool of RFID tags present. RFID tag **100** receives interrogation signals transmitted by one or more tag readers. According to interrogation protocols, RFID tag **100** responds to these signals. Each response includes information that identifies the corresponding RFID tag **100** of the potential pool of RFID tags present. Upon reception of a response, the tag reader determines the identity of the responding tag, thereby ascertaining the existence of the tag within a coverage area defined by the tag reader.

[0059] RFID tag **100** may be used in various applications, such as inventory control, airport baggage monitoring, as well as security and surveillance applications. Thus, RFID tag **100** can be affixed to items such as airline baggage, retail inventory, warehouse inventory, automobiles, compact discs (CDs), digital video discs (DVDs), video tapes, and other objects. RFID tag **100** enables location monitoring and real time tracking of such items.

[0060] In the present embodiment, die **104** is an integrated circuit that performs RFID operations, such as communicating with one or more tag readers (not shown) according to various interrogation protocols. Exemplary interrogation protocols are described in U.S. Pat. No. 6,002,344 issued Dec. 14, 1999 to Bandy et al. entitled System and Method for Electronic Inventory, and U.S. patent application Ser. No. 10/072,885, filed on Feb. 12, 2002, both of which are incorporated by reference herein in its entirety. Die **104** includes a plurality of contact pads that each provide an electrical connection with related electronics **106**.

[0061] Related electronics **106** are connected to die **104** through a plurality of contact pads of IC die **104**. In embodiments, related electronics **106** provide one or more capabilities, including RF reception and transmission capabilities, sensor functionality, power reception and storage functionality, as well as additional capabilities. The components of related electronics **106** can be printed onto a tag substrate **116** with materials, such as conductive inks. Examples of conductive inks include silver conductors **5000**, **5021**, and **5025**, produced by DuPont Electronic Materials of Research Triangle Park, N.C. Other materials or means suitable for printing related electronics **106** onto tag substrate **116** include polymeric dielectric composition **5018** and carbon-based PTC resistor paste **7282**, which are also produced by DuPont Electronic Materials of Research Triangle Park, N.C. Other materials or means that may be used to deposit the component material onto the substrate would be apparent to persons skilled in the relevant art(s) from the teachings herein.

[0062] As shown in **FIGS. 1A-1C**, tag substrate **116** has a first surface that accommodates die **104**, related electronics **106**, as well as further components of tag **100**. Tag substrate **116** also has a second surface that is opposite the first surface. An adhesive material or backing can be included on the second surface. When present, the adhesive backing enables tag **100** to be attached to objects, such as books and consumer products. Tag substrate **116** is made from a material, such as polyester, paper, plastic, fabrics such as cloth, and/or other materials such as commercially available Tyvec®.

[0063] In some implementations of tags **100**, tag substrate **116** can include an indentation, "cavity," or "cell" (not shown in **FIGS. 1A-1C**) that accommodates die **104**. An example of such an implementation is included in a "pads up" orientation of die **104**.

[0064] **FIGS. 2A and 2B** show plan and side views of an example die **104**. Die **104** includes four contact pads **204***a-d* that provide electrical connections between related electronics **106** and internal circuitry of die **104**. Note that although four contact pads **204***a-d* are shown, any number of contact pads may be used, depending on a particular application. Contact pads **204** are made of an electrically conductive material during fabrication of the die. Contact pads **204** can be further built up if required by the assembly process, by the deposition of additional and/or other materials, such as gold and solder flux. Such post processing, or "bumping," will be known to persons skilled in the relevant art(s).

[0065] **FIG. 2C** shows a portion of a substrate **116** with die **104** attached thereto, according to an example embodiment of the present invention. As shown in **FIG. 2C**, contact pads **204***a-d* of die **104** are coupled to respective contact areas **210***a-d* of substrate **116**. Contact areas **210***a-d* provide electrical connections to related electronics **106**. The arrangement of contact pads **204***a-d* in a rectangular (e.g., square) shape allows for flexibility in attachment of die **104** to substrate **116**, and good mechanical adherement. This arrangement allows for a range of tolerance for imperfect placement of IC die **104** on substrate **116**, while still achieving acceptable electrical coupling between contact pads **204***a-d* and contact areas **210***a-d*. For example, **FIG. 2D** shows an imperfect placement of IC die **104** on substrate **116**. However, even though IC die **104** has been improperly placed, acceptable electrical coupling is achieved between contact pads **204***a-d* and contact areas **210***a-d*.

[**0066**] Note that although **FIGS. 2A-2D** show the layout of four contact pads **204***a-d* collectively forming a rectangular shape, greater or lesser numbers of contact pads **204** may be used. Furthermore, contact pads **204***a-d* may be laid out in other shapes in embodiments of the present invention.

[**0067**] 2.0 RFID Tag Assembly

[**0068**] The present invention is directed to continuous-roll assembly techniques and other techniques for assembling tags, such as RFID tag **100**. Such techniques involve a continuous web (or roll) of the material of the tag antenna substrate **116** that is capable of being separated into a plurality of tags. Alternatively, separate sheets of the material can be used as discrete substrate webs that can be separated into a plurality of tags. As described herein, the manufactured one or more tags can then be post processed for individual use. For illustrative purposes, the techniques described herein are made with reference to assembly of RFID tag **100**. However, these techniques can be applied to other tag implementations and other suitable devices, as would be apparent to persons skilled in the relevant art(s) from the teachings herein.

[**0069**] The present invention advantageously eliminates the restriction of assembling electronic devices, such as RFID tags, one at a time, allowing multiple electronic devices to be assembled in parallel. The present invention provides a continuous-roll technique that is scalable and provides much higher throughput assembly rates than conventional pick and place techniques.

[**0070**] **FIG. 3** shows a flowchart **300** with example steps relating to continuous-roll production of RFID tags **100**, according to example embodiments of the present invention. **FIG. 3** shows a flowchart illustrating a process **300** for assembling tags **100**. Process **300** begins with a step **302**. In step **300**, a wafer **400** having a plurality of dies **104** is produced. **FIG. 4A** illustrates a plan view of an exemplary wafer **400**. As illustrated in **FIG. 4A**, a plurality of dies **104** are arranged in a plurality of rows **402***a-n*.

[**0071**] In a step **304**, wafer **400** is optionally applied to a support structure or surface **404**. Support surface **404** includes an adhesive material to provide adhesiveness. For example support surface **404** may be an adhesive tape that holds wafer **400** in place for subsequent processing. **FIG. 4B** shows an example view of wafer **400** in contact with an example support surface **404**. In some embodiments, wafer **400** does not need to be attached to a support surface, and can be operated on directly.

[**0072**] In a step **306**, the plurality of dies **104** on wafer **400** are separated. For example, step **306** may include scribing wafer **400** according to a process, such as laser etching. **FIG. 5** shows a view of wafer **400** having example separated dies **104** that are in contact with support surface **404**. **FIG. 5** shows a plurality of scribe lines **502***a*-**1** that indicate locations where dies **104** are separated.

[**0073**] In a step **308**, the plurality of dies **104** is transferred to a substrate. For example, dies **104** can be transferred from support surface **404** to tag substrates **116**. Alternatively, dies **104** can be directly transferred from wafer **400** to substrates **116**. In an embodiment, step **308** may allow for "pads down" transfer. Alternatively, step **308** may allow for "pads up" transfer. As used herein the terms "pads up" and "pads down" denote alternative implementations of tags **100**. In particular, these terms designate the orientation of connection pads **204** in relation to tag substrate **116**. In a "pads up" orientation for tag **100**, die **104** is transferred to tag substrate **116** with pads **204***a*-**204***d* facing away from tag substrate **116**. In a "pads down" orientation for tag **100**, die **104** is transferred to tag substrate **116** with pads **204***a*-**204***d* facing towards, and in contact with tag substrate **116**.

[**0074**] Note that step **308** may include multiple die transfer iterations. For example, in step **308**, dies **104** may be directly transferred from a wafer **400** to substrates **116**. Alternatively, dies **104** may be transferred to an intermediate structure, and subsequently transferred to substrates **116**. Example embodiments of such die transfer options are described below.

[**0075**] Note that steps **306** and **308** can be performed simultaneously in some embodiments. This is indicated in **FIG. 3** by step **320**, which includes both of steps **306** and **308**. Example embodiments where dies **104** of a wafer **400** are separated, and simultaneously transferred to a subsequent surface, are described below.

[**0076**] In a step **310**, post processing is performed. During step **310**, assembly of RFID tag(s) **100** is completed.

[**0077**] 2.1 Die Transfer Embodiments

[**0078**] Step **308** shown in **FIG. 3**, and discussed above, relates to transferring dies to a tag substrate. The dies can be attached to a support surface (e.g., as shown in **FIG. 5**), or can be transferred directly from the wafer, and can be transferred to the tag substrate by a variety of techniques. Conventionally, the transfer is accomplished using a pick and place tool. The pick and place tool uses a vacuum die collet controlled by a robotic mechanism that picks up the die from the support structure by a suction action, and holds the die securely in the die collet. The pick and place tool deposits the die into a die carrier or transfer surface. For example, a suitable transfer surface is a "punch tape" manufactured by Mulbauer, Germany. A disadvantage of the present pick and place approach is that only one die at a time may be transferred. Hence, the present pick and place approach does not scale well for very high throughput rates.

[**0079**] The present invention allows for the transfer of more than one die at a time from a support surface to a transfer surface. In fact, the present invention allows for the transfer of more than one die between any two surfaces, including transferring dies from a wafer or support surface to an intermediate surface, transferring dies between multiple intermediate surfaces, transferring dies between an intermediate surface and the final substrate surface, and transferring dies directly from a wafer or support surface to the final substrate surface.

[0080] **FIG. 6** shows a high-level system diagram **600** that provides a representation of the different modes or paths of transfer of dies from wafers to substrates. **FIG. 6** shows a wafer **400**, a web **608**, and a transfer surface **610**. Two paths are shown in **FIG. 6** for transferring dies, a first path **602**, which is a direct path, and a second path **604**, which is a path having intermediate steps. For example, as shown in **FIG. 6**, first path **602** leads directly from wafer **400** to web **608**. In other words, dies can be transferred from wafer **400** to substrates of web **608** directly, without the dies having first to be transferred from wafer **400** to another surface or storage structure. However, according to path **604**, at least two steps are required, path **604**A and path **604**B. For path **604**A, dies are first transferred from wafer **400** to an intermediate transfer surface **610**. The dies then are transferred from transfer surface **610** via path **604**B to the substrates of web **608**. Paths **602** and **604** each have their advantages. For example, path **602** can have fewer steps, but can have issues of die registration, and other difficulties. Path **604** typically has a larger number of steps than path **602**, but transfer of dies from wafer **400** to a transfer surface **610** can make die transfer to the substrates of web **608** easier, as die registration may be easier.

[0081] **FIGS. 7 and 8** show flowcharts providing steps for transferring dies from a first surface to a second surface, according to embodiments of the present invention. Structural embodiments of the present invention will be apparent to persons skilled in the relevant art(s) based on the following discussion. These steps are described in detail below.

[0082] Flowchart **700** begins with step **702**. In step **702**, a plurality of dies attached to a support surface is received. For example, the dies are dies **104**, which are shown attached to a support surface **404** in **FIG. 4A**. For example, the support surface can be a "green tape" or "blue tape" as would be known to persons skilled in the relevant art(s).

[0083] In step **704**, the plurality of dies are transferred to a subsequent surface. For example, dies **104** may be transferred according to embodiments of the present invention. For example, the dies may be transferred by an adhesive tape, a punch tape, a multi-barrel transport mechanism and/or process, die frame, pin plate, such as are further described below and/or in the incorporated patent applications, and may be transferred by other mechanisms and processes, or by combinations of the mechanisms/processes described herein. In embodiments, the subsequent surface can be an intermediate surface or an actual final substrate. For example, the intermediate surface can be a transfer surface, including a "blue tape," as would be known to persons skilled in the relevant art(s). When the subsequent surface is a substrate, the subsequent surface may be a substrate structure that includes a plurality of tag substrates, or may be another substrate type.

[0084] In block **706**, if the subsequent surface is a substrate to which the dies are going to be permanently attached, the process of flowchart **700** is complete. The process can then proceed to step **310** of flowchart **300**, if desired. If the subsequent surface is not a final surface, then the process proceeds to step **704**, where the plurality of dies are then transferred to another subsequent surface. Step **704** may be repeated as many times as is required by the particular application.

[0085] Flowchart **800** of **FIG. 8** is substantially similar to flowchart of **700**. However, instead of including step **702**, flowchart **800** includes step **802**. In step **802**, a wafer that includes a plurality of dies is received. Thus, in flowchart **800**, a wafer **400** is operated on directly, without being applied to a support surface or structure. Embodiments for both of flowcharts **700** and **800** are described herein.

[0086] Any of the intermediate/transfer surfaces and final substrate surfaces may or may not have cells formed therein for dies to reside therein. Various processes described below may be used to transfer multiple dies simultaneously between first and second surfaces, according to embodiments of the present invention. In any of the processes described herein, dies may be transferred in either pads-up or pads-down orientations from one surface to another.

[0087] The die transfer processes described herein include transfer using an adhesive surface, a parallel die punch process, die plates, including die receptacle structures, pin plates, die transfer heads, and die transfer head coverage patterns. Elements of the die transfer processes described herein may be combined in any way, as would be understood by persons skilled in the relevant art(s). These die transfer processes, and related example structures for performing these processes, are further described in the following subsections.

[0088] 2.1.1 Die Transfer onto a Die Plate

[0089] According to an embodiment of the present invention, a die plate is used for transferring dies from wafers or support surfaces to substrates or subsequent transfer services. According to die plate embodiments described herein, dies **104** can be attached to a surface of the die plate, being positioned over a corresponding hole of the die plate. Once a die is transferred to the die plate, the die can then be transferred to subsequent, intermediate/transfer surfaces, or to a final surface or structure, such as a substrate.

[0090] **FIG. 9** shows an example die plate **900**, according to an example embodiment of the present invention. As shown in **FIG. 9**, die plate **900** includes a body **902**. As shown in **FIG. 9**, body **902** is substantially planar. Body **902** can be manufactured using materials including a metal or combination of metals/alloy, a polymer, a plastic, glass, other materials, and any combination thereof. Furthermore, as shown in **FIG. 9**, body **902** has a plurality of openings or holes **906** formed therethrough. Holes **906** are open at both the top and bottom planar surfaces of body **902**. Although holes **906** are shown in **FIG. 9** as being substantially round or elliptical, they can have other shapes, including square or rectangular, or other shape.

[0091] FIGS. 10A-E show example schematic views of die plate **900**, according to an example embodiment. For example, **FIG. 10A** shows a die plate **900**, and shows the outline of a wafer **400** superimposed on top of die plate **900**. **FIG. 10B** also shows a die plate portion **1010** showing a close-up view of a surface of die plate **900**. As shown for portion **1010**, die plate **900** has a plurality of holes **906**, and in this particular embodiment, includes a plurality of grid lines **1002**. Grid lines **1002** can be formed on either or both of the bottom and top surfaces of die plate **900**. Grid lines **1002** can be used to indicate areas for placement of dies **104** on die plate **900** and/or can be used as guidelines for sawing or otherwise separating dies **104** on die plate **1002**. For example, grid lines **1002** can be grooves in the surface of die plate **900** for an end of a saw blade to pass through. **FIG. 10C** also shows a plan view of a die plate portion **1020**.

[0092] **FIG. 11** shows a perspective view of a die plate portion **1100**, according to an embodiment of the present invention. As shown in **FIG. 11**, die plate portion **1100** includes holes **906**, and grid lines **1002**, which are shown as grooves in the surface of die plate **900**.

[0093] **FIG. 12** shows example steps related to a flowchart **1200** for transferring dies from a support structure to die plate **900**, according to embodiments of the present invention. Further operational and structural embodiments of the present invention will be apparent to persons skilled in the relevant arts based on the following discussion.

[0094] **FIGS. 13-15** relate to the steps of flowchart **1200** of **FIG. 12**. **FIG. 13** shows a plurality of dies **104** attached in a pads-down fashion to a bottom surface of a support structure **404**. **FIG. 13** also shows a cross-sectional view of die plate **900**. As shown in **FIG. 13**, an adhesive material layer **1302** has been formed on the top surface of die plate **900**. Note that additionally or alternatively, an adhesive material can be applied to the bottom surfaces of dies **104**. Adhesive material layer **1302** may be any type of adhesive material, including an epoxy, an adhesive tape, or any other adhesive material.

[0095] **FIG. 14** shows an implementation of step **1202** of flowchart **1200** shown in **FIG. 12**. As shown in **FIG. 14**, support structure **404** and die plate **900** are positioned closely adjacent to each other, such that each die **104** attached to support structure **404** adheres to the top surface of die plate **900** due to adhesive material layer **1302**.

[0096] **FIG. 15** shows an example implementation of step **1204** of flowchart **1200** shown in **FIG. 12**. As shown in **FIG. 15**, each die **104** is released from support surface **404**, and therefore remains attached to die plate **900**. In an embodiment, for example, the adhesive force of adhesive material layer **1302** is stronger than the adhesive force of the bottom surface of support structure **404**. Thus, when support structure **404** is moved away from die plate **900**, dies **104** remain attached to die plate **900**. Thus, support structure may be peeled from die plate **900** to transfer dies **104**.

[0097] Note that although a vacuum source is not shown or used in **FIGS. 13-15**, in an alternative embodiment, a vacuum source can be used in the current embodiment to aid in transferring dies **104** to die plate **900**.

[0098] In further embodiments, dies **104** of a wafer **400** can be directly transferred to die plate **900**. **FIG. 16** shows example steps related to a flowchart **1600** for transferring dies from a wafer to die plate **900**, according to embodiments of the present invention. Further operational and structural embodiments of the present invention will be apparent to persons skilled in the relevant arts based on the following discussion.

[0099] **FIGS. 17-19** relate to the steps of flowchart **1600** shown in **FIG. 16**. For example, **FIG. 17** shows an example wafer having a plurality of dies included therein, being positioned adjacent to a die plate **900**. Note that in an embodiment, wafer **400** has been thinned so that it has a thickness of approximately the thickness of a die. Furthermore, as shown in **FIG. 17**, an adhesive material layer **1302** has been applied to the top surface of die plate **900**. Note that additionally, or alternatively, an adhesive material may be applied to the bottom surface of wafer **400**.

[0100] **FIG. 18** shows an example implementation of step **1602** of flowchart **1600** shown in **FIG. 16**. As shown in **FIG. 18**, wafer **400** and die plate **900** are positioned closely adjacent to each other such that wafer **400** adheres to the first surface of die plate **900**. Note that die plate **900** and wafer **400** are positioned such that each die **104** of wafer **400** covers a corresponding hole **906** through die plate **900** at the first or top surface of die plate **900**.

[0101] **FIG. 19** shows an example implementation of step **1604** of flowchart **1600** shown in **FIG. 16**. As shown in **FIG. 19**, each of dies **104** are scribed/separated from wafer **400** so that they remain attached to the top surface of die plate **900**. For example, as shown in **FIGS. 18 and 19**, a saw mechanism **1802** can be used to separate the dies **104** of wafer **400**. The blade of saw mechanism **1802** may track the grooves or lines of grid **1002** which can be optionally formed in the top surface of die plate **900**. Saw mechanism **1802** can be a saw blade or other cutting device, can be a laser, or any other sawing or cutting device suitable for separating dies from a wafer **400**.

[0102] 2.1.1.1 Die Transfer onto a Die Plate from Partially Cut Adhesive Surface

[0103] **FIGS. 20-26** show various views of a transfer of dies to a die plate, and subsequently to one or more substrates, according to embodiments of the present invention. **FIG. 20** shows a wafer **400** attached in a pads-up fashion to a surface of a support structure **404**. For example, wafer **400** and support structure **400** may be held in a conventional wafer frame or other holding mechanism. As shown in **FIG. 20**, a first die **104** is being separated from wafer **400**. For example, as shown in **FIG. 20**, a saw mechanism **1802** (or other suitable device or process) can be used to scribe/separate die **104** of wafer **400**. Furthermore, saw mechanism **1802** penetrates and cuts/separates a groove depth **2002** of the total thickness **2004** of support structure **404** when separating first die **104**_a_ from wafer **400**, to form grooves **2006**. Groove depth **2002** can be any portion of the thickness **2004** of support structure **404**, as required by the particular application. As shown in **FIG. 20**, groove depth **2002** can be greater than 50% of thickness **2004**, including approximately 90% of thickness **2004**.

[0104] Note that although **FIG. 20** shows dies **104** being separated when grooves **2006** are formed, in another embodiment, dies **104** may already have been separated before grooves **2006** are formed. Thus, in such an embodiment, grooves **2006** may be formed in a subsequent processing step to the actual scribing of wafer **400**. Thus, the present application is applicable to using scribed and unscribed wafers.

[0105] **FIG. 21** shows wafer **400** having a plurality of dies **104**_a-d_ separated, with grooves **2006**_a-e_ formed in support structure **404** around each of the plurality of dies **104**. Furthermore, **FIG. 21** shows wafer **400** being positioned adjacent to a die plate **900** in preparation for transfer of dies **104** to die plate **900**. Note that because grooves **2006** penetrate support structure **404** around each die **104**, potentially weakening support structure **404**, support structure **404** may sag when being positioned adjacent to die plate **900**. Such sagging of support structure **404** may create difficulties in precisely aligning dies **104** over corresponding holes **906** through die plate **900**. Thus, if groove depth **2002** is great enough to cause significant sagging of support structure **404**, a vacuum and/or positive pressure may be used to reduce or eliminate the sagging. For example, **FIG. 22** shows a pressure source **2202** used to provide a positive pressure. For example pressure source **2202** provides a gas pressure **2204** directed through holes **906** of die plate **900** to reduce sag in support structure **404** when support structure **404** and die plate **900** are being moved into contact. Alternatively or additionally, a vacuum source may be applied to support structure **404** (e.g., from above support structure **404** in **FIG. 22**) to provide a vacuum/suction to reduce sag in support structure **404**.

[0106] **FIG. 23** shows support structure **404** and die plate **900** positioned closely adjacent to each other such that support structure **404** adheres to the first surface of die plate **900**. Note that die plate **900** and wafer **400** are positioned such that each of dies **104***a-d* covers a corresponding hole **906***a-d* through die plate **900** at the first or top surface of die plate **900**.

[0107] **FIG. 24** shows a close up view of a die **104***a* of **FIG. 23**, where die plate **900** attaching support structure **404** and dies **104** has been inverted. As shown in **FIG. 24**, a pin **2402** is inserted in hole **906***a* to be used to push/punch die **104***a* from die plate **900**. **FIG. 25** shows pin **2402** moving through hole **906***a* of die plate **900** to contact support structure **404** opposite of die **104***a*, to push die **104***a* in contact with a substrate **2502**. Pin **2402** separates die **104***a* from support structure **404** by tearing/ripping support structure **404** around the perimeter of die **104***a*, such as at perimeter portions **2504***a* and **2504***b* in **FIG. 24** (an adhesiveness of substrate **2502** may also contribute to this tearing/ripping of support structure **404**).

[0108] Note that pin **2402** may be coupled to a pin plate having a plurality of pins **2402** that push/punch a plurality of dies **104** from die plate **900** in parallel onto the same or multiple substrates. For example, in a multiple substrate embodiment, the substrates may be separate, or joined together in a web of substrates. For further information on example pin plates, refer to co-pending U.S. Application Serial No. ______, titled "Method, System, And Apparatus For Transfer Of Dies Using A Pin Plate," having the same filing date as the present application, which is incorporated by reference in its entirety herein.

[0109] **FIG. 26** shows die **104***a* on substrate **2502**, having been separated from support structure **404** by pin **2402**. As shown in **FIG. 26** portion **2602** of support structure **404** remains attached to die **104***a*. Portion **2602** of support structure **404** helps to protect die **104***a* from damage due to pin **2402** during transfer of die **104** to substrate **2502**. Portion **2602** attached to die **104***a* can subsequently be removed from die **104***a* if desired, or can remain on die **104***a* when the respective tag or other device including substrate **2502** is completed. For example, portion **2602** can remain on die **104***a* to provide environmental protection for die **104***a*.

[0110] **FIG. 27** shows a flowchart providing steps for transferring dies, according to embodiments of the present invention. For example, **FIG. 27** relates to the transfer of dies shown in **FIGS. 20-26**. Further structural embodiments of the present invention will be apparent to persons skilled in the relevant art(s) based on the following discussion. These steps are described in detail below.

[0111] In step **2702**, grooves are formed in a first surface of a support structure that attaches a plurality of dies. For example, the grooves are grooves **2006** formed in support structure **404**, as shown in **FIGS. 20-25**. Note that the dies attached to the support structure may be separate on the support structure, or included in a wafer, prior to formation of the grooves.

[0112] In step **2704**, a second surface of the support structure and a die plate are moved into contact with each other so that the support structure attaches to the die plate. For example, as shown in **FIG. 23**, the bottom surface of support structure **404** is moved into contact with die plate **900**, to become attached to die plate **900**. Note that in an embodiment, as described above, a positive pressure can be applied to the support structure to reduce sag in the support structure.

[0113] In an embodiment, flowchart **2700** includes step **2706**. In step **2706**, at least one hole through the die plate is punched through to transfer a corresponding die from the die plate to a destination surface. For example, as shown in **FIGS. 24 and 25**, pin **2402** passes through hole **906***a* to transfer die **104***a* from die plate **900** to substrate **2502**. Note that in an embodiment, the support structure around the corresponding die is torn to release the die from the support structure. In an embodiment, a portion of the support structure remains attached to the die.

[0114] 2.1.2 Example Die Plate Embodiments

[0115] As described above, FIGS. **10**A-E show example schematic views of die plate **900**, according to an illustrative embodiment of the present invention. As described above, a die plate can be made from a variety of materials. In an embodiment, a die plate is made from the same material as a corresponding pin plate is made, or from a material having the same coefficient of thermal expansion (CTE) as a corresponding pin plate, so that the die plate and pin plate will expand and contract uniformly due to changes in temperature. For example, a die plate and corresponding pin plate can be from aluminum. In another example, one of the die plate and corresponding pin plate are made from Kapton, while the other is made from aluminum, because Kapton and aluminum have very similar CTE values. Alternatively, both can be made from Kapton.

[0116] As described above, **FIG. 10A** shows a die plate **900**, and shows the outline of a wafer **400** superimposed on top of die plate **900**. Die plate **900** can have any shape and size, as required by a particular application. For example, die plate **900** shown in **FIG. 10A** can have a width and length of approximately 254 mm. Wafer **400** can have a diameter of approximately 203 mm, for example. Die plate **900** can have holes **906** spaced according to any distances, as required by a particular application. For example, in one embodiment, die plate **900** can have a hole pattern of 103×205 holes spaced apart 2 mm horizontally and 1 mm vertically for a total number of 21,115 holes (e.g., for rectangular die). Such a pattern can cover a 204 mm×204 mm pattern (from hole center to hole center).

[0117] **FIG. 10C** shows a plan view of a die plate portion **1020**. Holes **906** can have any diameter, as required by a particular application. Typically, holes **906** have a diameter less than or equal to a minimum of the width and length of a corresponding die. For example, hole **906** shown in **FIG. 10C** can have a diameter of approximately 0.584 mm to accommodate a die having a width of approximately 0.949

mm and a length of approximately 1.949 mm. **FIGS. 10D and 10E** show cross-sectional views of portions of die plate **900**. Grooves **1002** can have any widths and depths, as required by a particular application. For example, grooves **1002** shown in **FIGS. 10D and 10E** can have widths of approximately 0.051 mm and depths of approximately 0.051 mm.

[**0118**] It is noted that any of the sizes/dimensions, spacings, numbers of holes, etc., described above are provided for illustrative purposes. It will be apparent to persons skilled in the relevant art(s) that these parameters can be modified as needed for a particular application. For example, these parameters can be modified for particular wafer sizes, die sizes, number of dies to be transferred in parallel, etc.

CONCLUSION

[**0119**] While various embodiments of the present invention have been described above, it should be understood that they have been presented by way of example, and not limitation. It will be apparent to persons skilled in the relevant arts that various changes in form and detail can be made therein without departing from the spirit and scope of the invention. Thus the present invention should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents.

What is claimed is:

1. A method for transferring a plurality of integrated circuit dies that are attached to a support structure to a die plate, comprising:

(a) positioning the support structure and die plate to be closely adjacent to each other such that each die of a plurality of dies attached to the support structure adheres to a first surface of the die plate due to an adhesive material; and

(b) releasing each die of the plurality of dies from the support structure so that each die remains attached to the die plate.

2. The method of claim 1, wherein step (b) comprises:

moving apart the support structure and die plate.

3. The method of claim 2, wherein said moving step comprises:

moving apart the support structure and die plate so that each die remains attached to the die plate due to the adhesive material overcoming an adhesiveness of the support structure.

4. The method of claim 2, wherein step (a) comprises:

positioning the support structure and die plate to be closely adjacent to each other such that each die of the plurality of dies covers a corresponding hole through the die plate, wherein each hole is open at the first surface and second surface of the die plate.

5. The method of claim 4, further comprising:

(c) applying a suction at a second surface of the die plate that further adheres each die to the die plate due to the corresponding hole.

6. The method of claim 1, further comprising:

(c) applying the adhesive material to the first surface of the die plate.

7. The method of claim 1, wherein a first surface of each die is attached to the support structure, further comprising:

(c) applying the adhesive material to a second surface of each die of the plurality of dies.

8. The method of claim 2, wherein the support structure is a tape structure, wherein said moving step comprises:

peeling the support structure from the die plate.

9. A method for transferring a plurality of integrated circuit dies from a wafer to a die plate, comprising:

(a) positioning the wafer and die plate to be closely adjacent to each other such that the wafer adheres to a first surface of the die plate due to an adhesive material, wherein the die plate includes a plurality of holes, wherein each hole is open at the first surface and a second surface of the die plate, wherein each die of a plurality of dies of the wafer covers a corresponding hole through the die plate; and

(b) separating each die of the plurality of dies from the wafer so that each die remains on the die plate.

10. The method of claim 9, wherein step (b) comprises:

sawing each die of the plurality of dies from the wafer.

11. The method of claim 10, wherein said sawing step comprising:

sawing along grooves in the first surface of the die plate that are positioned at boundaries between adjacent dies of the plurality of dies of the wafer.

12. The method of claim 9, further comprising:

(c) applying a suction at a second surface of the die plate that further adheres the wafer to the die plate due to the plurality of holes.

13. The method of claim 9, further comprising:

(c) applying the adhesive material to the first surface of the die plate.

14. The method of claim 9, further comprising:

(c) applying the adhesive material to a surface of the wafer.

15. The method of claim 9 wherein step (b) comprises:

using a laser to separate each die of the plurality of dies from the wafer.

16. A method for transferring a plurality of integrated circuit dies, comprising:

(a) forming grooves in a first surface of a support structure that attaches a plurality of dies, wherein the grooves are formed in the surface of the support structure between the dies; and

(b) moving a second surface of the support structure and a die plate into contact with each other so that the support structure attaches to the die plate, and so that a portion of the support structure attaching each die of the plurality of dies covers a corresponding hole through the die plate.

17. The method of claim 16, wherein the plurality of dies are included in a wafer, wherein step (a) comprises:

cutting through the wafer to separate the dies from the wafer and to form the grooves in the surface of the support structure.

18. The method of claim 16, wherein the plurality of dies are separate on the support structure, wherein step (a) comprises:

forming the grooves in the surface of the support structure through channels between the dies.

19. The method of claim 16, further comprising:

(c) applying a positive pressure to the support structure to reduce sag in the support structure.

20. The method of claim 16, further comprising:

(c) punching through at least one hole through the die plate to transfer a corresponding die from the die plate to a destination surface.

21. The method of claim 20, wherein step (c) comprises:

tearing the support structure around the corresponding die to release the die from the support structure, wherein a portion of the support structure remains attached to the die.

22. A die plate, comprising:

a planar body,

wherein said body comprises a plurality of holes therethrough.

23. The die plate of claim 22, further comprising:

a die attachment position corresponding to each hole of said plurality of holes.

24. The die plate of claim 23, wherein each hole has a diameter less than or equal to (≦) a width of an integrated circuit die.

25. The die plate of claim 22, wherein said plurality of holes are arranged in an array defined by a plurality of rows and a plurality of columns of holes.

26. The die plate of claim 25, comprising a plurality of grooves in a first surface of said die plate.

27. The die plate of claim 26, wherein said plurality of grooves are positioned between said rows of holes and between said columns of holes in said first surface.

28. The die plate of claim 26, wherein said plurality of grooves are used during scribing of a wafer attached to said die plate.

29. The die plate of claim 22, further comprising an adhesive material covering at least a portion of a first surface of said planar body.

30. A system for transferring dies, comprising:

a die plate, comprising:

a planar body,

wherein said body comprises a plurality of holes therethrough.

31. The system of claim 30, further comprising:

a frame that holds a support structure that attaches a plurality of dies.

32. The system of claim 31, further comprising:

a wafer separator for separating the plurality of dies from a wafer on the support structure.

33. The system of claim 32, wherein the wafer separator includes a wafer saw.

34. The system of claim 32, wherein the wafer separator includes a laser.

35. The system of claim 30, further comprising:

a vacuum source.

36. The system of claim 30, further comprising:

a positive pressure source.

37. The system of claim 30, further comprising:

a pin plate that mounts at least one pin, wherein said at least one pin is used to pass through at least one corresponding hole of said plurality of holes to punch at least one corresponding die from said die plate.

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