micrometers, a copper or gold seed layer 1413 having a thickness between 0.002 and 0.1 micrometers on the adhesion layer 1412, and an electroplated copper or gold layer 1405 on the copper or gold seed layer 1413. If the layer 1405 is electroplated copper, an optional nickel layer 1414 formed by a suitable process or processes, e.g., by an electroplating or electroless plating process can be provided on the electroplated copper layer1405, and an optional gold layer 1415 formed by a suitable process or processes, e.g., by an electroplating or electroless plating process can be provided on the nickel layer 1414. Optionally, each of the DRAM chips 1392 may contain another polymer 1416, such as polyimide or benzocyclobutene (BCB) having a thickness between 2 and 30 micrometers, on the redistribution circuit layer 1411 and on the polymer layer 1409, and openings 1417 in the polymer layer 1416 are over the contact points 1418, configured for wirebonding, of the redistribution circuit layer 1411, and the contact points 1418 are at bottoms of the openings 1417. Alternatively, the polymer layer 1409 can be omitted. The redistribution circuit layer 1411 can be provided directly on the passivation layer 5 and there is no polymer layer between the passivation layer 5 and the redistribution circuit layer 1411. Alternatively, the polymer layer 1416 can be omitted and there is no polymer layer over the redistribution circuit layer 1411.

[001283] Figs. 48B and 48G show top perspective views of the DRAM chip 1392 according to two embodiments. Referring to Fig. 48G, the contact points 1408 are arranged in a center line 1403 of the DRAM chip 1392 parallel with two opposite edges 1392a and 1392b of the DRAM chip. Alternatively, referring to Fig. 48B, the contact points 1408 are arranged in two center lines 1421 and 1422 left and right away from the center line 1403 of the DRAM chip 1392, respectively, and parallel with the two opposite edges 1392a and 1392b of the DRAM chip. The region 1419 shown in Figs. 48B and 48G enclosed by dot lines indicates a region of a top surface of the silicon semiconductor substrate 1, in which the off-chip drivers or receivers 42 are provided, that is, there can be off-chip drivers or receivers 42 at a horizontal plane lower than that of the contact points 1408, and each of the off-chip drivers or receivers 42 is connected to and positioned close to one of the contact points 1408, as shown in Figs. 48C-48F and 48H-48K. In a case, there is no off-chip driver or receiver vertically under the contact points 1408, as shown in Figs. 48C, 48E, 48H and 48J. For example, the off-chip driver or receiver 42, as shown in Figs. 48C and 48E, is at a horizontal plane lower than that of the contact point 1408 connected to the off-chip driver or receiver 42 and has a horizontal offset p from the center of the contact point 1408 by a range from 30 to 250 micrometers, with the contact points 1408 shown in Fig. 48B arranged in two center lines 1421 and 1422 left and

right away from the center line 1403 of the DRAM chip 1392, respectively. Also, when the contact points 1408, as shown in Fig. 48G, are arranged in a center line 1403 of the DRAM chip 1392 parallel with two opposite edges 1392a and 1392b of the DRAM chip, the off-chip driver or receiver 42 at a horizontal plane lower than that of the contact point 1408 connected to the off-chip driver or receiver 42 may have a horizontal offset p from the center of the contact point 1408 by a range from 30 to 250 micrometers, as shown in Figs. 48H and 48J.

[001284] In another case, there can be off-chip drivers or receivers 42 vertically under the contact points 1408. As shown in Fig. 48D and 48F, the contact points 1408 can be vertically over and connected to the off-chip driver or receiver 42, with the contact points 1408 shown in Fig. 48B arranged in two center lines 1421 and 1422 left and right away from the center line 1403 of the DRAM chip 1392, respectively, and a width or diameter D of the opening 1407 in the passivation layer 5 can be as small as possible, and, for example, can be between 0.2 and 20 micrometers, and preferably between 0.5 and 5 micrometers. Also, when the contact points 1408, as shown in Fig. 48G, are arranged in a center line 1403 of the DRAM chip 1392 parallel with two opposite edges 1392a and 1392b of the DRAM chip, the contact points 1408, as shown in Figs. 48I and 48K, can be vertically over and connected to the off-chip driver or receiver 42, and a width or diameter D of the opening 1407 in the passivation layer 5 can be as small as possible, and, for example, can be between 0.2 and 20 micrometers, and preferably between 0.5 and 5 micrometers.

[001285] Referring to Figs. 48B and 48G, the distance s between the left or right edge and the center line 1403 of the DRAM chip 1392 may range from 150 and 500 micrometers. Four of the eight memory banks 1404 are at the left side of the region 1419 and the other four of the eight memory banks 1404 are at the right side of the region 1419. Referring to Fig. 48G, the redistribution circuit layer 1411 can be patterned with multiple redistributed traces 1411a each connecting one of the contact points 1408 to one of the contact points 1418, configured for wirebonding, arranged in a line close to the edge 1392a. Alternatively, referring to Fig. 48B, the redistribution circuit layer 1411 can be patterned with multiple redistributed traces 1411a each connecting one of the contact points 1408 to one of the contact points 1418, configured for wirebonding, arranged in two lines close to the edge 1392a.

[001286] A plurality of the previously described DRAM chip 1392 as illustrated in Figs.48B-48K can be stacked. For example, there could be four, eight, sixteen or thirty two of DRAM chips 1392 are stacked, as described below:

[001287] Referring to Fig. 48A, the bottommost DRAM chip 1392 can be mounted onto the BGA substrate 1391 by adhering the silicon semiconductor substrate 1 of the bottommost DRAM chip 1392 to the top side of the BGA substrate 1391 using a film 1420 of a glue material, such as a polymer or an epoxy-based material, with a thickness between 1 and 50 micrometers. The upper DRAM chip 1392 can be mounted onto the lower DRAM chip 1392 by adhering the silicon substrate 1 of the upper DRAM chip 1392 to the top side of the lower chip 1392 using another film 1420 of the glue material. The control chip 1996 can be mounted onto the topmost DRAM chip 1392 by adhering the control chip 1996 to the top side of the topmost DRAM chip 1392 using another film 1420 of the glue material. The upper DRAM chip 1392 has a right portion overhanging the lower DRAM chip 1392, and the lower DRAM chip 1392 has a left portion not vertically under the upper DRAM chip 1392. The upper DRAM chip 1392 has a left sidewall recessed from that of the lower DRAM chip 1392. The wirebonded wires 1394 each may have an end bonded with the contact point 1418 of the upper DRAM chip 1392 or the contact point 1433 of the control chip 1996 and another end bonded with the contact point 1418 of the lower DRAM chip 1392 or with a metal pad 1399 of the BGA substrate 1391. Particularly, in case the wirebonded wires 1394 are copper wires, the wirebonded wires 1394 each may have an end bonded with the electroplated copper layer 1405 of the upper DRAM chip 1392 or with copper of the contact point 1433 of the control chip 1996 and another end bonded with the electroplated copper layer 1405 of the lower DRAM chip 1392 or with copper of the metal pad 1399 of the BGA substrate 1391. In case the wirebonded wires 1394 are gold wires, the wirebonded wires 1394 each may have an end bonded with the sputtered aluminum layer 1402, the electroplated gold layer 1405 or the gold layer 1415 of the upper DRAM chip 1392 or with gold or aluminum of the contact point 1433 of the control chip 1996 and another end bonded with the sputtered aluminum layer 1402, the electroplated gold layer 1405 or the gold layer 1415 of the lower DRAM chip 1392 or with gold of the metal pad 1399 of the BGA substrate 1391.

[001288] The previously described module 137 shown in Fig. 37A, 37B, 37C, 37D, 38A, 38B, 38C or 38D may include only one processor unit 303 on the substrate 301 or BGA substrate 302. Alternatively, the module 137 may include a plurality of the processor unit 303 on the substrate 301 or BGA substrate 302, and the way to assembly either one of the processor units 303 and to design the circuit of either one of the processor units 303 can be referenced to as either one of the ways to assembly the processor unit 303 shown in Fig. 37A, 37B, 37C,

37D, 38A, 38B, 38C or 38D and to design the circuit of the processor unit 303 shown in Fig. 39A, 39H, 39I or 39J.

[001289] For example, the module 137 may include three processor units 303 on the substrate 301 or BGA substrate 302. The chip 313 in one of the processor units 303 can be a central-processing-unit (CPU) chip designed by x86 architecture or designed by non x86 architectures, the chip 313 in another one of the processor units 303 can be a graphics-processing-unit (GPU) chip, and the chip 313 in the other one of the processor units 303 can be a baseband chip.

[001290] Alternatively, the module 137 may include two processor units 303 on the substrate 301 or BGA substrate 302. The chip 313 in one of the processor units 303 can be a system-on chip (SOC) including a graphics-processing-unit (GPU) circuit block, a wireless local area network (WLAN) circuit block and a central-processing-unit (CPU) circuit block designed by x86 architecture or by non x86 architectures, and the chip 313 in the other one of the processor units 303 can be a baseband chip.

[001291] Alternatively, the module 137 may include two processor units 303 on the substrate 301 or BGA substrate 302. The chip 313 in one of the processor units 303 can be a system-on chip (SOC) including a baseband circuit block, a wireless local area network (WLAN) circuit block and a central-processing-unit (CPU) circuit block designed by x86 architecture or by non x86 architectures, and the chip 313 in the other one of the processor units 303 can be a graphics-processing-unit (GPU) chip.

[001292] The previously described module 137 shown in Fig. 37A, 37B, 37C, 37D, 38A, 38B, 38C or 38D, the previously described chip-package module 118 shown in Fig. 36A, the previously described chip-package module 118a shown in Fig. 36B, the previously described chip-package module 118b shown in Fig. 36C, the previously described chip-package module 118c shown in Fig. 36D, the previously described semiconductor chips shown in Figs. 29A-29T, the previously described semiconductor chip cut from the previously described semiconductor wafer 10, and the previously described chip package including the previously described semiconductor chip cut from the previously described semiconductor wafer 10 can be used for a telephone, a cordless phone, a mobile phone, a smart phone, a netbook computer, a notebook computer, a digital camera, a digital video camera, a digital picture frame, a personal digital assistant (PDA), a pocket personal computer, a portable personal computer, an electronic book, a digital book, a desktop computer, a tablet or slate computer, an automobile

electronic product, a mobile internet device (MID), a mobile television, a projector, a mobile projector, a pico projector, a smart projector, a 3D video display, a 3D television (3D TV), a 3D video game player, a mobile computer device, a mobile compuphone (also called mobile phoneputer or mobile personal computer phone) which is a device or a system combining and providing functions of computers and phones, or a high performance and/or low power computer or server, for example, used for cloud computing.

[001293] When the module 137 shown in Fig. 37A, 37B, 37C, 37D, 38A, 38B, 38C or 38D is used for the mobile compuphone, the memory size of the mass storage provided by the wirebonded stacked memory BGA package 138 is larger than 4 gigabytes, such as between 4 gigabytes and 1 trillion bytes, and the memory size of the main memory provided by the stacked DRAM BGA package 139 is larger than 100 megabytes, such as between 100 megabytes and 256 gigabytes, and preferably between 256 megabytes and 64 gigabytes.

[001294] When the module 137 shown in Fig. 37A, 37B, 37C, 37D, 38A, 38B, 38C or 38D is used for the high performance and/or low power computer or server, the 3D video display, such as 3D television (3D TV), or the 3D video game player, and the high performance and/or low power computer or server, for example, can be used for cloud computing, the memory size of the mass storage provided by the wirebonded stacked memory BGA package 138 is larger than 4 gigabytes, such as between 4 gigabytes and 128 trillion bytes, and preferably between 64 gigabytes and 1 trillion bytes, and the memory size of the main memory provided by the stacked DRAM BGA package 139 is larger than 256 megabytes, such as between 256 megabytes and 1 trillion bytes, and preferably between 1 and 256 gigabytes.

[001295] When the module 137 shown in Fig. 37A, 37B, 37C, 37D, 38A, 38B, 38C or 38D is used for the mobile compuphone, the cache memory chip 311 can be a dynamic-random-access-memory (DRAM) chip, a synchronous-dynamic-random-access-memory (SDRAM) chip or a statistic-random-access-memory (SRAM) chip, and the memory size of the cache memory chip 311 is between 10 megabytes and 32 gigabytes, and preferably between 100 megabytes and 4 gigabytes.

[001296] When the module 137 shown in Fig. 37A, 37B, 37C, 37D, 38A, 38B, 38C or 38D is used for the high performance and/or low power computer or server, the 3D video display or the 3D video game player, the cache memory chip 311 can be a dynamic-random-access-memory (DRAM) chip, a statistic-random-access-memory (SRAM)

chip or a synchronous-dynamic-random-access-memory (SDRAM) chip, and the memory size of the cache memory chip 311 is between 10 megabytes and 32 gigabytes, and preferably between 100 megabytes and 4 gigabytes.

[001297] The module 137 shown in Fig. 37A, 37B, 37C, 37D, 38A, 38B, 38C or 38D, for example, can be provide for a high performance video display, especially for 3D video display, and can be connected to an in-situ (built-in) video display or in-situ (built-in) 3D video display, or can be connected to an external 3D video display, such as 3D TV or 3D video game player.

[001298] Alternatively, in Fig. 37A, 37B, 37C, 37D, 38A, 38B, 38C or 38D, the chip 313 may be a memory chip, such as synchronous-dynamic-random-access-memory (SDRAM) chip, statistic-random-access-memory (SRAM) chip or dynamic-random-access-memory (DRAM) chip, while the chip 311 may be a central-processing-unit (CPU) chip designed by x86 architecture, a central-processing-unit (CPU) chip designed by non x86 architectures, such as ARM, Strong ARM or MIPs, a baseband chip, a graphics-processing-unit (GPU) chip, a digital-signal-processing (DSP) chip, a wireless local area network (WLAN) chip, a global-positioning-system (GPS) chip, a bluetooth chip, a system-on chip (SOC) including a graphics-processing-unit (GPU) circuit block, a wireless local area network (WLAN) circuit block and a central-processing-unit (CPU) circuit block designed by x86 architecture or by non x86 architectures, but not including any baseband circuit block, a system-on chip (SOC) including a baseband circuit block, a wireless local area network (WLAN) circuit block and a central-processing-unit (CPU) circuit block designed by x86 architecture or by non x86 architectures, but not including any graphics-processing-unit (GPU) circuit block, a system-on chip (SOC) including a baseband circuit block, a graphics-processing-unit (GPU) circuit block and a central-processing-unit (CPU) circuit block designed by x86 architecture or by non x86 architectures, but not including any wireless local area network (WLAN) circuit block, a system-on chip (SOC) including a baseband circuit block and a wireless local area network (WLAN) circuit block, but not including any graphics-processing-unit (GPU) circuit block and any central-processing-unit (CPU) circuit block, a system-on chip (SOC) including a graphics-processing-unit (GPU) circuit block and a wireless local area network (WLAN) circuit block, but not including any baseband circuit block and any central-processing-unit (CPU) circuit block, a system-on chip (SOC) including a graphics-processing-unit (GPU) circuit block, a baseband circuit block, a digital-signal-processing (DSP) circuit block, a wireless local area network (WLAN) circuit block and a central-processing-unit (CPU) circuit block designed by x86 architecture or by non x86 architectures, or a chip including a

central-processing-unit (CPU) circuit block, a bluetooth circuit block, a global-positioning-system (GPS) circuit block, a graphics-processing-unit (GPU) circuit block, a baseband circuit block, a digital-signal-processing (DSP) circuit block, and/or a wireless local area network (WLAN) circuit block. It is noted that this architechture can be also designed with the circuits illustrated in Fig. 39A, 39H, 39I or 39J.

[001299] Accordingly, aspects and embodiments of the present disclosure can provide benefits and advantages over previous techniques

[001300] The components, steps, features, benefits and advantages that have been discussed are merely illustrative. None of them, nor the discussions relating to them, are intended to limit the scope of protection in any way. Numerous other embodiments are also contemplated. These include embodiments that have fewer, additional, and/or different components, steps, features, benefits and advantages. These also include embodiments in which the components and/or steps are arranged and/or ordered differently.

[001301] In reading the present disclosure, one skilled in the art will appreciate that embodiments of the present disclosure can be implemented in or facilitated by computer hardware, software, firmware, or any combinations of such, and over one or more networks. Suitable software can include computer-readable or machine-readable instructions for performing methods and techniques (and portions thereof) of designing and/or controlling the fabrication of chip structures in accordance with the present disclosure. Any suitable software language (machine-dependent or machine-independent) may be utilized. Moreover, embodiments of the present disclosure can be included in or carried by various signals, e.g., as transmitted over a wireless RF or IR communications link or downloaded from the Internet.

[001302] Unless otherwise stated, all measurements, values, ratings, positions, magnitudes, sizes, and other specifications that are set forth in this specification, including in the claims that follow, are approximate or of a nominal value, and not necessarily exact; they are intended to have a reasonable range that is consistent with the functions to which they relate and with what is customary in the art to which they pertain.

[001303] All articles, patents, patent applications, and other publications which have been cited in this disclosure are hereby incorporated herein by reference.

[001304] Nothing that has been stated or illustrated is intended or should be interpreted to cause a dedication of any component, step, feature, object, benefit, advantage, or equivalent to the public, regardless of whether it is recited in the claims.

[001305] The scope of protection is limited solely by the claims. That scope is intended and should be interpreted to be as broad as is consistent with the ordinary meaning of the language that is used in the claims when interpreted in light of this specification and the prosecution history that follows and to encompass all structural and functional equivalents.

CLAIMS

What is claimed is:

1. A module comprising:

a substrate;

a processor unit on said substrate, wherein said processor unit comprises a first cache memory chip over said substrate and a processor chip over said first cache memory chip, wherein said first cache memory chip is connected to said processor chip through a plurality of microbumps between said first cache memory chip and said processor chip, wherein a pitch between a neighboring two of said plurality of microbumps is smaller than 60 micrometers;

a mass storage on said substrate, wherein said mass storage comprises a first memory chip over said substrate and a second memory chip over said first memory chip, wherein said first memory chip is connected to said second memory chip through at least one first wirebonded wire;

a main memory on said substrate, wherein said main memory comprises a first dynamic-random-access-memory chip over said substrate and a second dynamic-random-access-memory chip over said first dynamic-random-access-memory chip; and

a connector connected to said substrate.

2. The module of claim 1, wherein the module is implemented in a computer, a mobile phone, a mobile compuphone, a camera, an electronic book, a digital picture frame, an automobile electronic product, a 3D video display, a 3D television, a 3D video game player, a projector, or a server used for cloud computing.

3. The module of claim 1, wherein said processor chip comprises a central-processing-unit (CPU) circuit block designed by x86 architecture or by non x86 architectures, a graphics-processing-unit (GPU) circuit block, a baseband circuit block, a digital-signal-processing (DSP) circuit block, or a wireless local area network (WLAN) circuit block.

4. The module of claim 1, wherein said processor chip comprises a central-processing-unit (CPU) chip designed by x86 architecture or by non x86 architectures.

5. The module of claim 1, wherein said processor chip comprises a system-on chip (SOC) comprising a baseband circuit block, a wireless local area network (WLAN) circuit block and a central-processing-unit (CPU) circuit block designed by x86 architecture or by non x86 architectures, but not comprising any graphics-processing-unit (GPU) circuit block.

6. The module of claim 1, wherein said first cache memory chip comprises a dynamic-random-access-memory (DRAM) chip, a synchronous-dynamic-random-access-memory (SDRAM) chip, or a static-random-access-memory (SRAM) chip.

7. The module of claim 1, wherein said first cache memory chip has a memory size between 10 megabytes and 32 gigabytes.

8. The module of claim 1, wherein said first cache memory chip is connected to said substrate through at least one second wirebonded wire.

9. The module of claim 1, wherein said first cache memory chip comprises a silicon substrate, a plurality of through-silicon vias in said silicon substrate, a bottom scheme at a backside of said silicon substrate and in said plurality of through-silicon vias, a first dielectric layer over a top side of said silicon substrate, a first metal layer over said first dielectric layer, a second dielectric layer over said first metal layer, a second metal layer over said second dielectric layer, and a passivation layer over said top side of said silicon substrate, over said first and second dielectric layers and over said first and second metal layers, wherein each of a plurality of openings in said passivation layer is over a respective one of a plurality of contact points of said second metal layer, and said plurality of contact points is at bottoms of said plurality of openings, wherein said plurality of microbumps is connected to said plurality of contact points through said plurality of openings, wherein said bottom scheme comprises a metal bump between said silicon substrate and said substrate, wherein said first cache memory chip is connected to said substrate through said metal bump.

10. The module of claim 1, wherein said first memory chip comprises a flash memory chip or a dynamic-random-access-memory (DRAM) chip.

11. The module of claim 1, wherein said processor unit further comprises a second cache memory chip over said processor chip, wherein said second cache memory chip is connected to said processor chip.

12. The module of claim 1, wherein said second memory chip has a right portion overhanging said first memory chip, and said first memory chip has a left portion not vertically under said second memory chip, wherein said second memory chip has a left sidewall recessed from that of said first memory chip.

13. The module of claim 1 further comprising a radio frequency (RF) module on said substrate.

14. The module of claim 1, wherein said first dynamic-random-access-memory chip comprises a first silicon substrate, a first dielectric layer over said first silicon substrate, a first metal layer over said first dielectric layer, a second dielectric layer over said first metal layer, a second metal layer over said second dielectric layer, and a first passivation layer over said first silicon substrate, over said first and second dielectric layers and over said first and second metal layers, wherein each of a plurality of openings in said first passivation layer is over a respective one of a plurality of contact points of said second metal layer, and said plurality of contact points is at bottoms of said plurality of openings, wherein said second dynamic-random-access-memory chip comprises a second silicon substrate, a plurality of through-silicon vias in said second silicon substrate, a bottom scheme at a backside of said second silicon substrate and in said plurality of through-silicon vias, a third dielectric layer over a top side of said second silicon substrate, a third metal layer over said third dielectric layer, a fourth dielectric layer over said third metal layer, a fourth metal layer over said fourth dielectric layer, and a second passivation layer over said top side of said second silicon substrate, over said third and fourth dielectric layers and over said third and fourth metal layers, wherein said bottom scheme comprises a metal bump between said second silicon substrate and said first dynamic-random-access-memory chip, wherein said metal bump is connected to one of said plurality of contact points through one of said plurality of openings, wherein said second

dynamic-random-access-memory chip is connected to said first dynamic-random-access-memory chip through said metal bump.

15. The module of claim 1, wherein said connector is used for connecting to a charger, a game player, a display, or a television.

16. The module of claim 1, wherein said connector comprises a universal serial bus (USB), a high-definition multimedia interface (HDMI), a DisplayPort, an IEEE 1394, or an optical connector.

17. The module of claim 1, wherein said first cache memory chip comprises a first metal pad, a second metal pad, a testing interface circuit having a first node connected to said first metal pad, a first inter-chip buffer connected to said first metal pad and to said first node of said testing interface circuit, an off-chip buffer having a first node connected to a second node of said testing interface circuit and a second node connected to said second metal pad, and an off-chip electro static discharge (ESD) circuit connected to said second node of said off-chip buffer and to said second metal pad, wherein one of said plurality of microbumps is on said first metal pad, wherein said one of said plurality of microbumps is connected to said first inter-chip buffer and to said first node of said testing interface circuit through said first metal pad, wherein said second metal pad is not connected upwards to said processor chip through any microbump between said first cache memory chip and said processor chip.

18. The module of claim 17, wherein said off-chip buffer comprises a first NMOS transistor, and said first inter-chip buffer comprises a second NMOS transistor, wherein a ratio of a physical channel width to a physical channel length of said first NMOS transistor is greater than a ratio of a physical channel width to a physical channel length of said second NMOS transistor by more than 3 times.

19. The module of claim 17, wherein said processor chip comprises a third metal pad and a second inter-chip buffer connected to said third metal pad, wherein said one of said plurality of microbumps is between said first and third metal pads, wherein said one of said plurality of microbumps is connected to said second inter-chip buffer through said third metal pad, wherein said first inter-chip buffer is connected to said second inter-chip buffer through, in

sequence, said first metal pad, said one of said plurality of microbumps, and said third metal pad.

20. The module of claim 19, wherein there is no electro static discharge (ESD) circuit connected to a path between said first inter-chip buffer and said second inter-chip buffer.

AMENDED CLAIMS
received by the International Bureau on 10 Jul 2010 (10.07.2010)

What is claimed is:

1. (Currently Amended) A chip package comprising:

a first chip;

a second chip vertically over said first chip, wherein said second chip comprises a silicon substrate and a metal interconnect in a through-silicon via passing through said silicon substrate;

a first metal bump between said first and second chips, wherein a buffer of said second chip is connected to a buffer of said first chip through said first metal bump, wherein an output capacitance seen from said buffer of said second chip is smaller than 2 pF; and

a second metal bump between said first and second chips, wherein said metal interconnect is connected to said first chip through said second metal bump.

2. (Currently Amended) The chip package of claim 1 further comprising an underfill between said first and second chips, wherein said underfill encloses said first and second metal bumps.

3. (Currently Amended) The chip package of claim 1 further comprising a third chip vertically over said second chip, and a third metal bump between said second and third chips, wherein said third chip is connected to said metal interconnect through said third metal bump.

4. (Currently Amended) The chip package of claim 3 further comprising an underfill between said second and third chips, wherein said underfill encloses said third metal bump.

5. (Currently Amended) The chip package of claim 3, wherein said third metal bump comprises a first nickel layer, a second nickel layer and a tin-containing layer between said first and second nickel layers.

6. (Currently Amended) The chip package of claim 5, wherein said first nickel layer has a thickness between 2 and 20 micrometers.

7. (Currently Amended) The chip package of claim 5, wherein said first nickel layer has a thickness between 2 and 20 micrometers, and said second nickel layer has a thickness between 2 and 20 micrometers.

8. (Currently Amended) The chip package of claim 1, wherein said buffer of said second chip comprises a driver, and said buffer of said first chip comprises a receiver.

9. (Currently Amended) The chip package of claim 1, wherein said buffer of said second chip comprises a tri-state buffer, and said buffer of said first chip comprises another tri-state buffer.

10. (Currently Amended) The chip package of claim 1, wherein said metal interconnect comprises a copper layer in said through-silicon via.

11. (Currently Amended) The chip package of claim 10, wherein said metal interconnect further comprises a titanium-containing layer in said through-silicon via, at a sidewall of said through-silicon via and between said copper layer and said silicon substrate.

12. (Currently Amended) The chip package of claim 1, wherein said second chip comprises a metal layer under said silicon substrate, wherein said through-silicon via is over a contact point of said metal layer, and said contact point is at a bottom of said through-silicon via, wherein said metal interconnect is further on said contact point and over said silicon substrate.

13. (Currently Amended) The chip package of claim 1, wherein said first metal bump comprises a tin-containing layer between said first and second chips.

14. (Currently Amended) The chip package of claim 13, wherein said first metal bump further comprises a copper layer having a thickness between 2 and 20 micrometers between said tin-containing layer and said second chip.

15. (Currently Amended) The chip package of claim 13, wherein said first metal bump further comprises a nickel layer having a thickness between 2 and 20 micrometers between said tin-containing layer and said second chip.

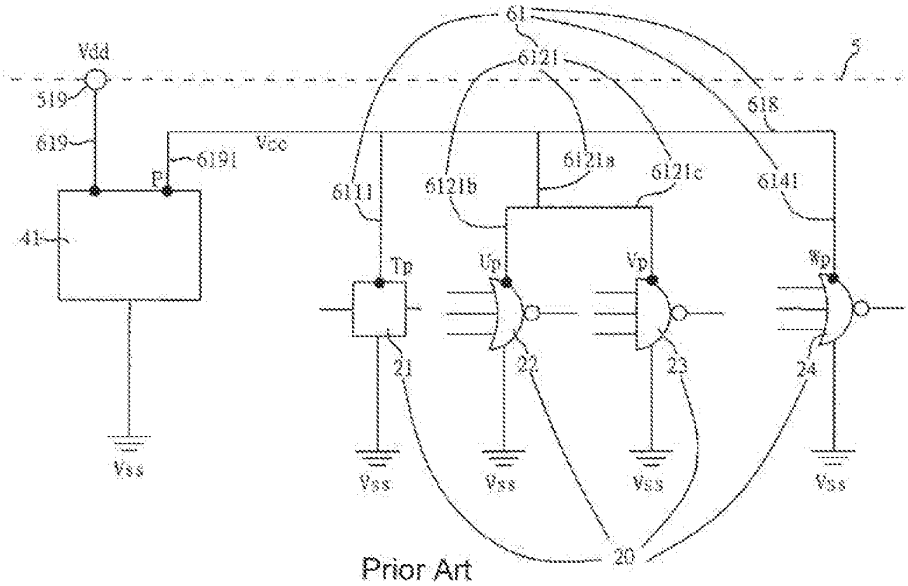
16. (Currently Amended) The chip package of claim 13, wherein said first metal bump further comprises a copper layer having a thickness between 2 and 20 micrometers between said tin-containing layer and said first chip.

17. (Currently Amended) The chip package of claim 13, wherein said first metal bump further comprises a nickel layer having a thickness between 2 and 20 micrometers between said tin-containing layer and said first chip.

18. (Currently Amended) The chip package of claim 1, wherein said first chip further comprises an ESD circuit connected to said buffer of said first chip and said first metal bump, wherein said ESD circuit has a capacitance smaller than 2 pF.

19. (Currently Amended) The chip package of claim 1, wherein said second chip further comprises an ESD circuit connected to said buffer of said second chip and said first metal bump, wherein said ESD circuit has a capacitance smaller than 2 pF.

20. (Currently Amended) The chip package of claim 1, further comprising a wirebonded wire bonded on said first chip.



Prior Art

Fig. 1A

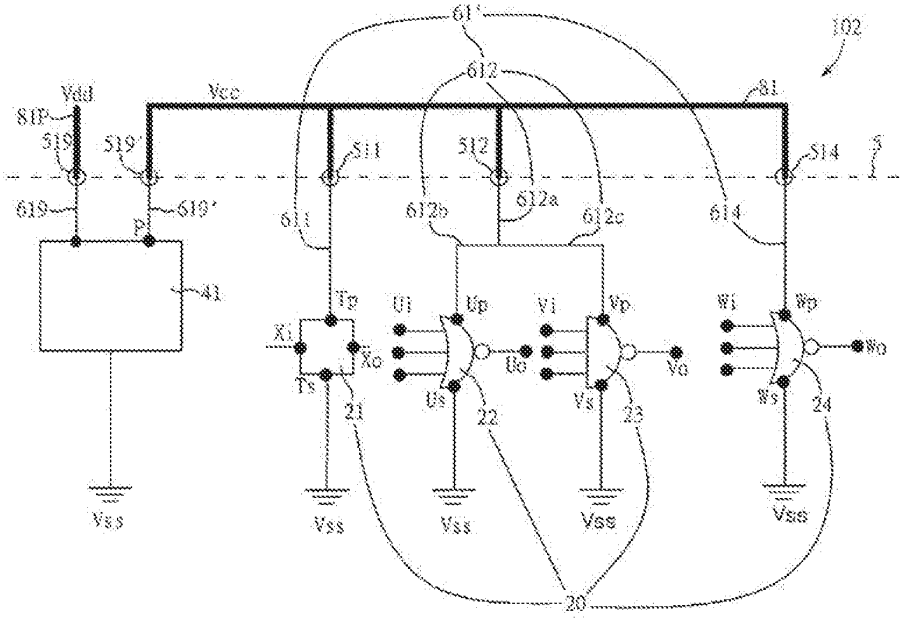


Fig. 1B

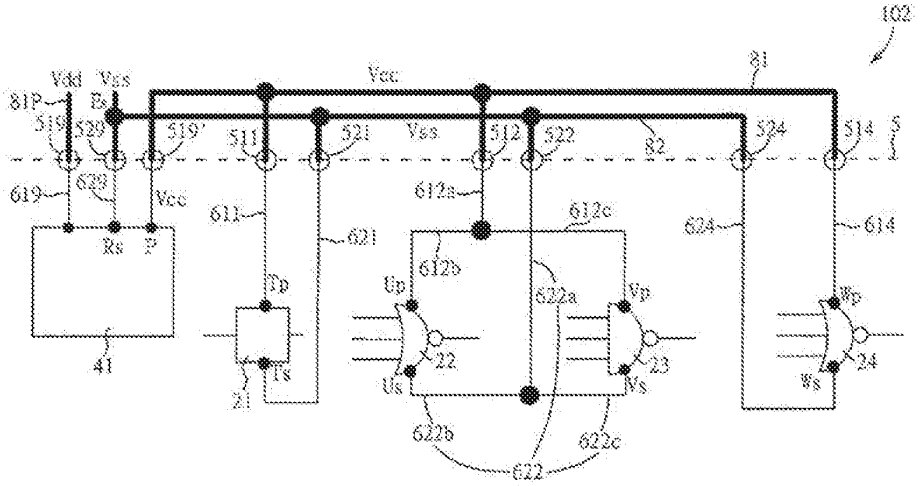

102
81
Vdd
Vss
Vcc
81P
Es
519
520
519'
511
521
Vss
512
522
82
524
514
5
619
629
Vcc
611
621
612a
612c
624
614
612b
622a
Rs
P
Dp
Up
Vp
Wp
22
23
24
41
21
Ts
Us
Vs
Ws
622b
622c
622

Fig. 1C

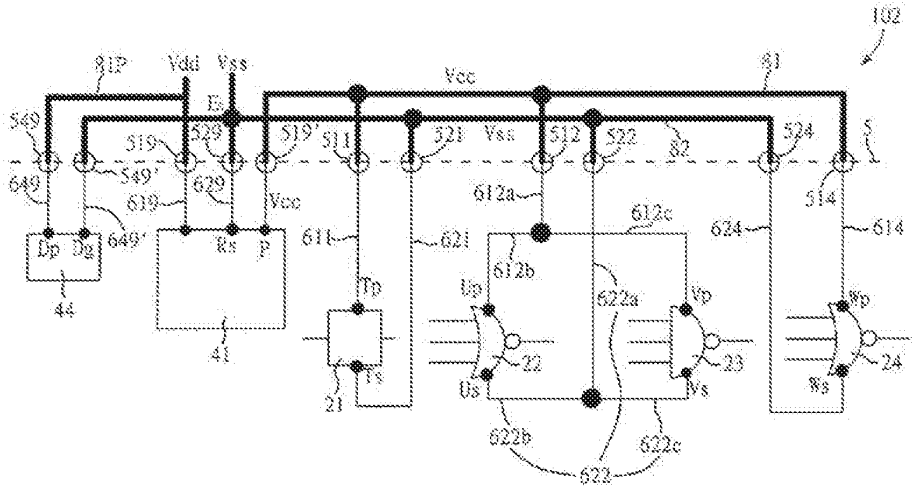

102
81P
Vdd
Vss
Vcc
81
Es
540
519
529
519'
511
521
Vss
512
522
82
524
5
549
549'
649
619
629
Vcc
612a
612c
624
514
614
Dp
Dg
649'
Rs
P
611
621
612b
622a
Up
Vp
Wp
44
41
Tp
22
23
24
21
Ts
Us
Vs
Ws
622b
622c
622

Fig. 1D

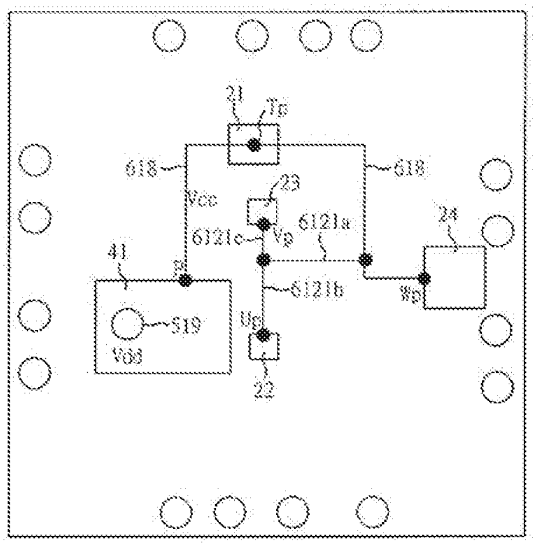


Fig. 2A
Prior Art

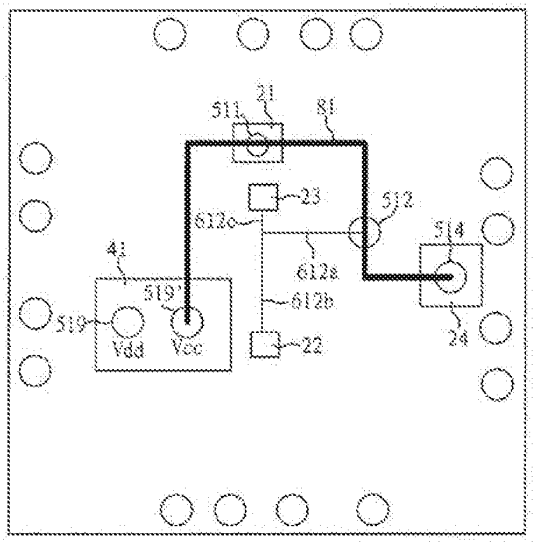

511
21
81
23
512
613c
514
41
612a
519'
612b
519
Vdd
Vcc
22
24

Fig. 2B

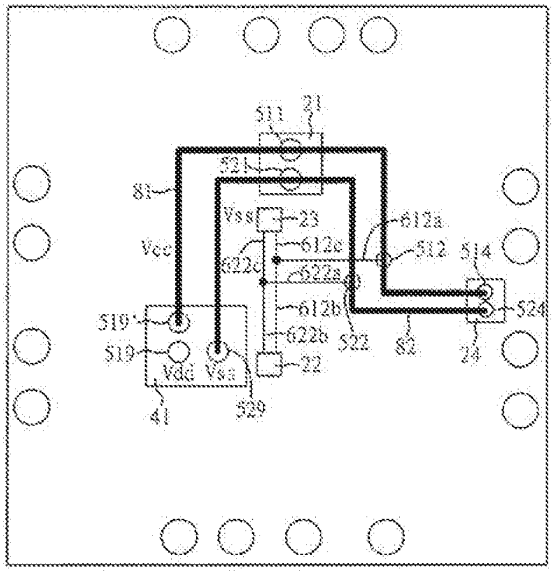

511
21
521
81
Vss
23
612a
Vcc
612c
512
514
622c
522a
519'
612b
524
519
622b
522
82
24
Vdd
Vcc
22
41
520

Fig. 2C

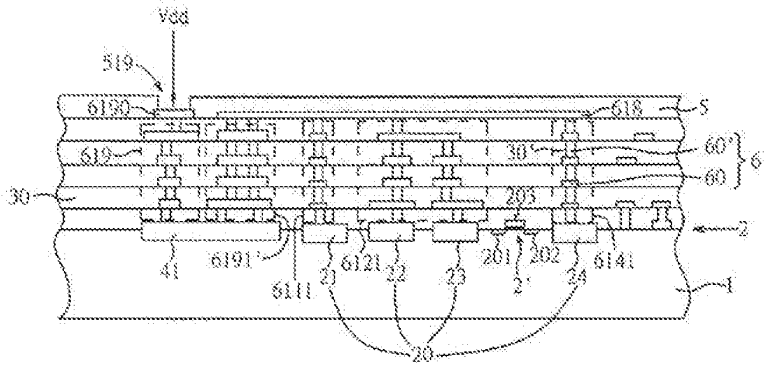


Fig. 3A
Prior Art

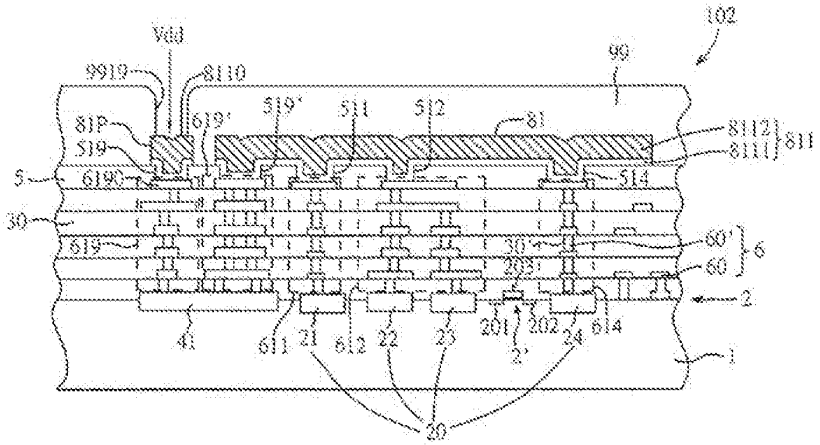


Fig. 3B

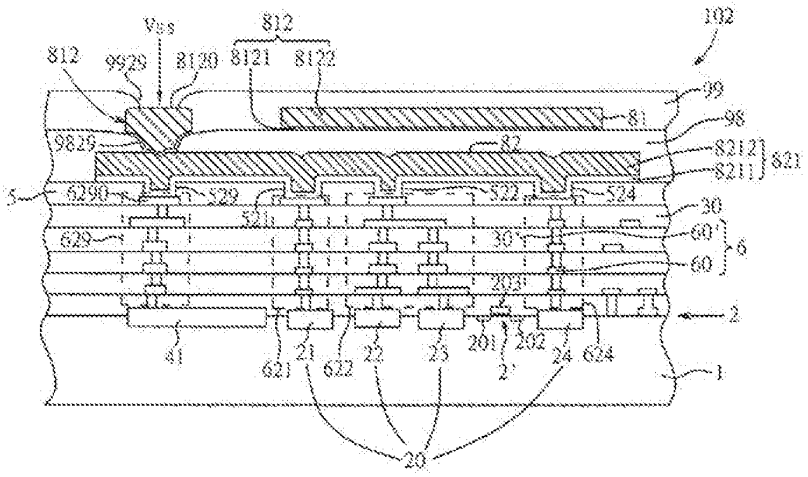

V_{SS}
812
812
9929
8130
8121
8122
102
99
98
81
82
9829
8212
8211
821
5
6290
529
521
522
524
30
60'
6
629
30'
60
203
2
41
621
21
622
22
23
201
202
2'
24
624
1
20

Fig. 3C

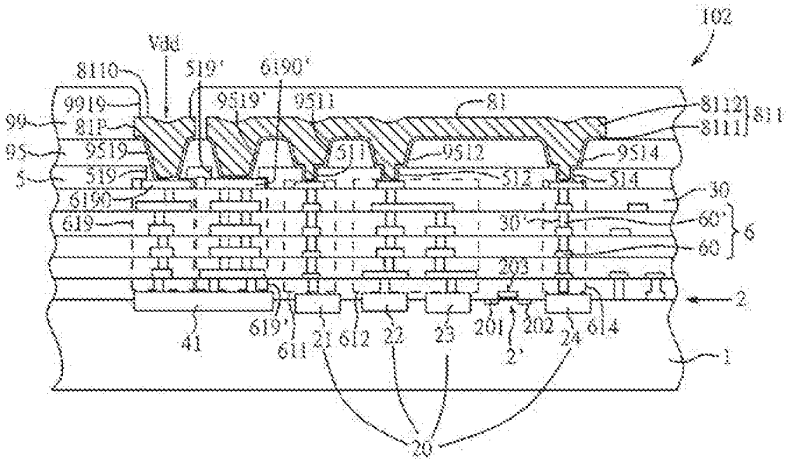

102
V_{dd}
8110
519'
6190'
9919
9519'
9511
81
8112
811
8111
90
819
95
9519
511
9512
9514
5
519
512
514
30
6190
619
60'
6
30'
60
203
2
41
619'
611
21
612
22
23
201
202
2'
24
614
1
20

Fig. 3D

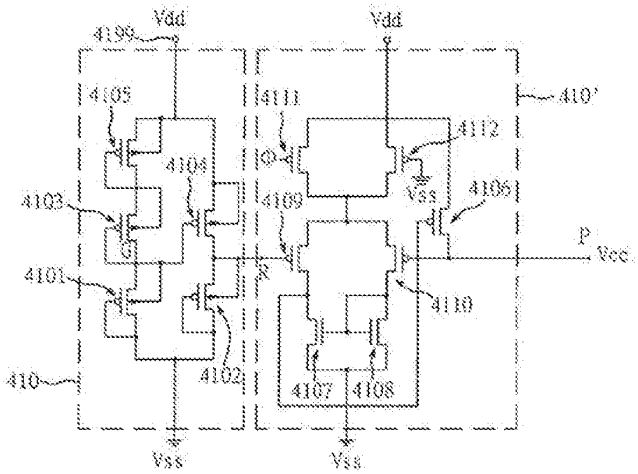

Vdd
Vdd
4105
4111
410'
4112
4104
Vss
4106
4103
4109
P
Vcc
4101
4110
410
4102
4107
4108
Vss
Vss

Fig. 4

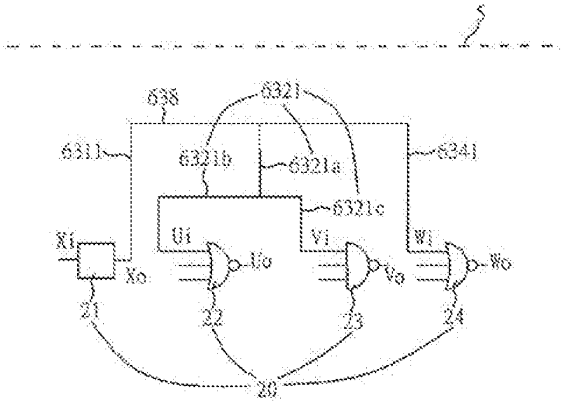

5
638
6321
6311
6321b
6321a
6341
6321c
Ui
Vi
Wi
Xi
Xo
Uo
Vo
Wo
21
22
23
24
20

Fig. 5A

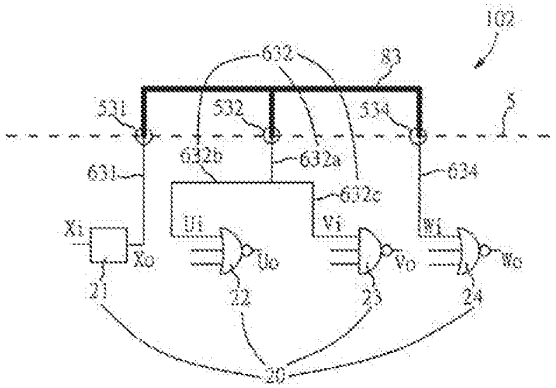

102
632
83
531
532
534
5
632b
632a
631
634
632c
X1
Xo
Yo
Vo
Wo
21
22
23
24
20

Fig. 5B

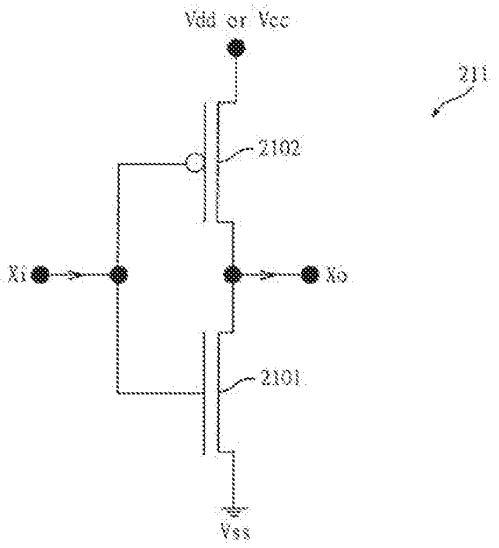

Vdd or Vcc
211
2102
Xi
Xo
2101
Vss

Fig. 5C

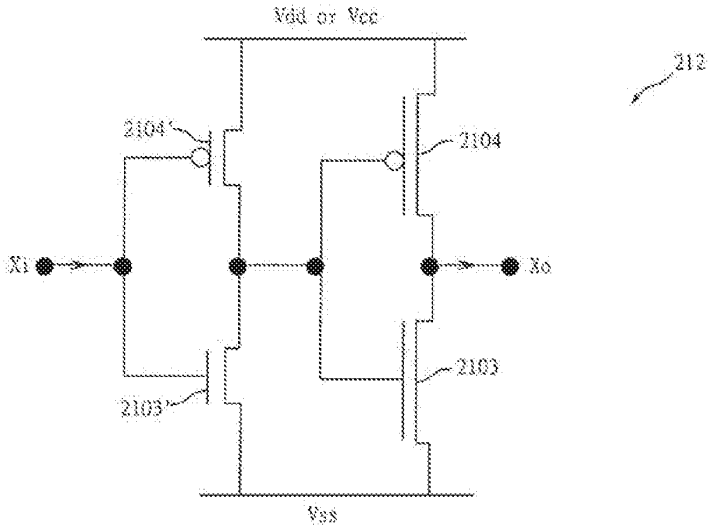

Vdd or Vcc
212
2104'
2104
Xi
Xo
2103
2103'
Vss

Fig. 5D

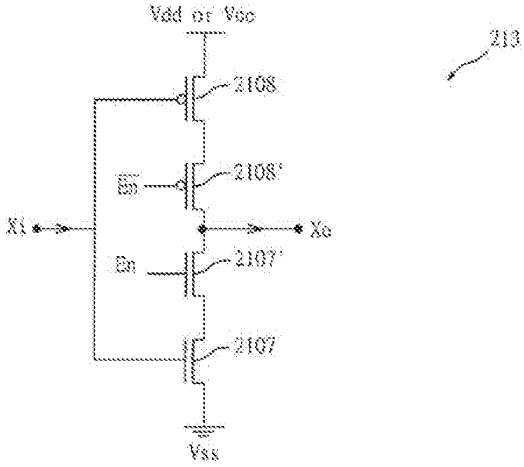

Vdd or Vcc
213
2108
2108'
Xi
Xo
2107'
2107
Vss

Fig. 5E

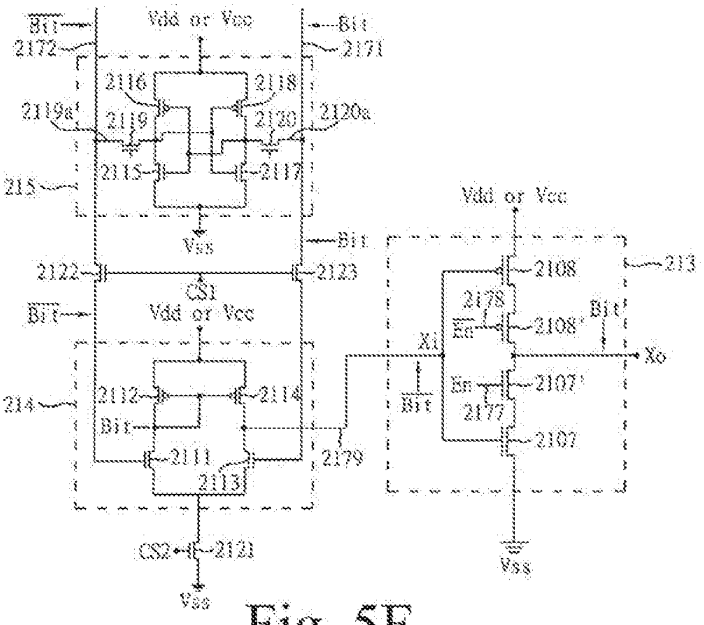

Bit
Vdd or Vcc
2172
2171
2116
2118
2119a
2119
2120
2120a
2115
2117
215
Vss
2122
2123
CS1
Vdd or Vcc
214
2112
2114
2111
2113
2179
CS2
2121
2108
213
2178
2108'
Xi
Xo
2107'
2177
2107

Fig. 5F

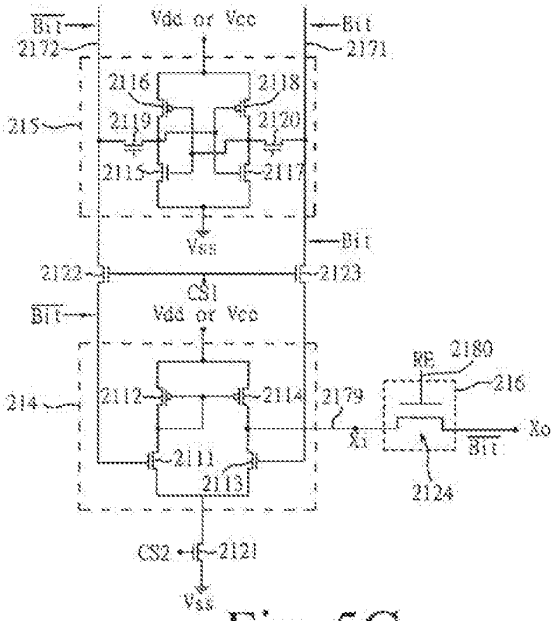

Bit
Vdd or Vcc
2172
2171
2116
2118
215
2119
2120
2115
2117
Vss
2122
2123
CS1
214
2112
2114
2179
2111
2113
RE
2180
216
Xi
Xo
2124
CS2
2121

Fig. 5G

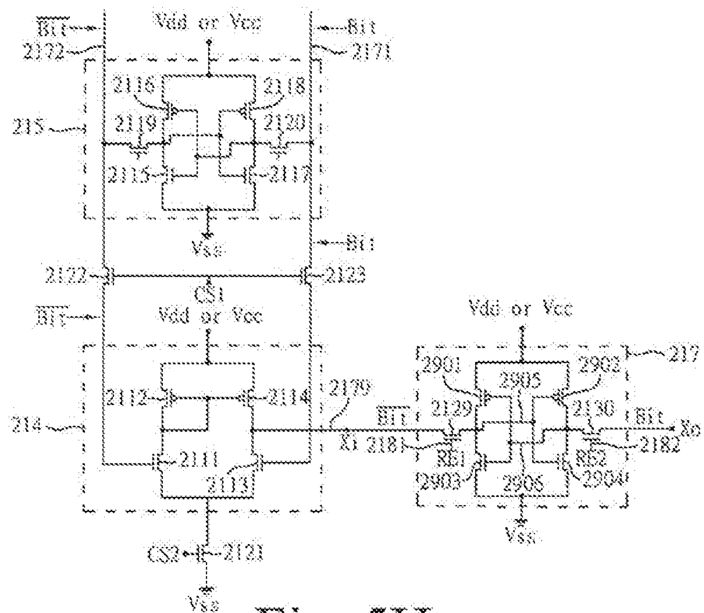

Vdd or Vcc
Bit
2172
2171
2116
2118
2119
2120
215
2115
2117
Vss
2122
2123
CS1
2114
2112
2170
214
2111
2113
CS2
2121
217
2901
2902
2905
2129
2130
2181
2182
RE1
RE2
2903
2906
2904
Xi
Xo

Fig. 5H

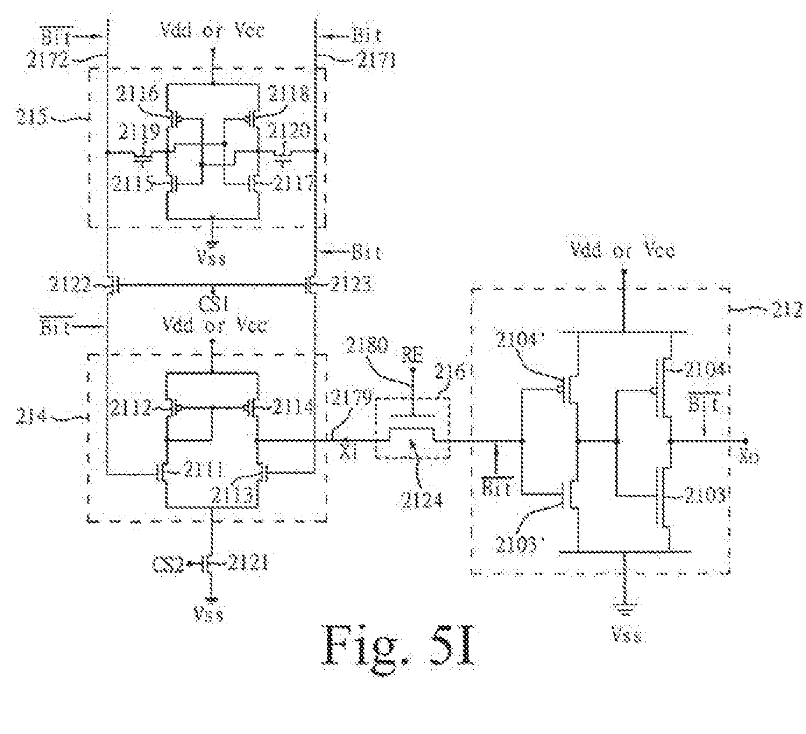

Vdd or Vcc
Bit
2172
2171
2116
2118
2119
2120
215
2115
2117
Vss
2122
2123
CS1
214
2112
2114
2111
2113
2179
2180
RE
216
2124
Xi
212
2104'
2104
2103'
2103
Xo
CS2
2121

Fig. 5I

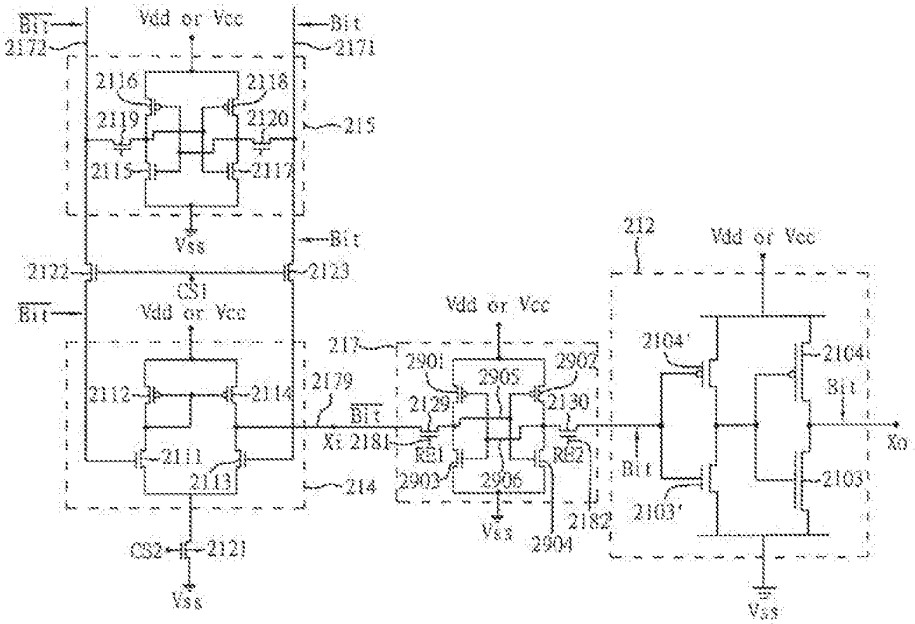

Bit
2172
Vdd or Vcc
Bit
2171
2116
2118
2119
2120
215
2115
2117
Vss
Bit
2122
2123
CS1
Bit
Vdd or Vcc
Vdd or Vcc
217
2901
2902
2905
2179
2112
2114
2129
2130
Bit
Xi 2181
RS1
RS2
2111
2113
214
2903
2906
2182
Vss
2904
CS2
2121
Vss
212
Vdd or Vcc
2104'
2104
Bit
Xo
Bit
2103'
2103
Vss

Fig. 5J

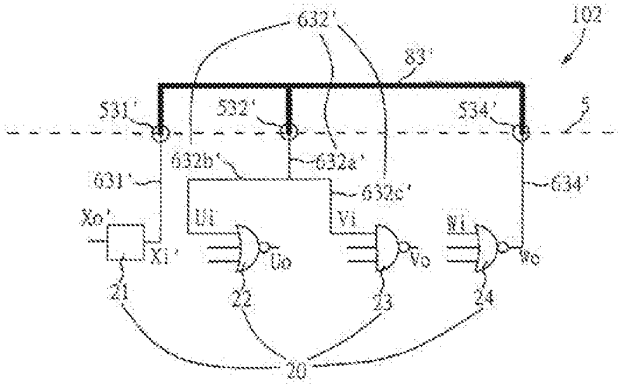

632'
102
83'
531'
532'
534'
5
632b'
632a'
632c'
631'
634'
Xo'
Xi'
WI
Uo
VI
Vo
RI
Wo
21
22
23
24
20

Fig. 5K

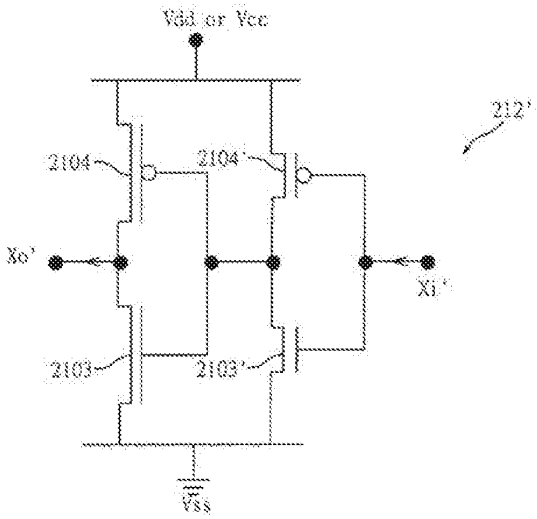

Vdd or Vcc
212'
2104
2104'
Xo'
Xi'
2103
2103'
Vss

Fig. 5L

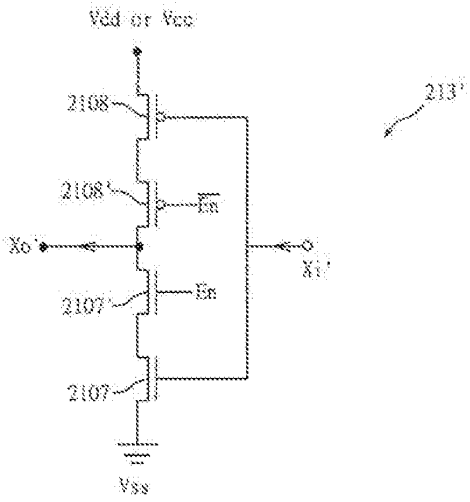

Vdd or Vcc
213'
2108
2108'
En
Xo'
Xi'
2107'
En
2107
Vss

Fig. 5M

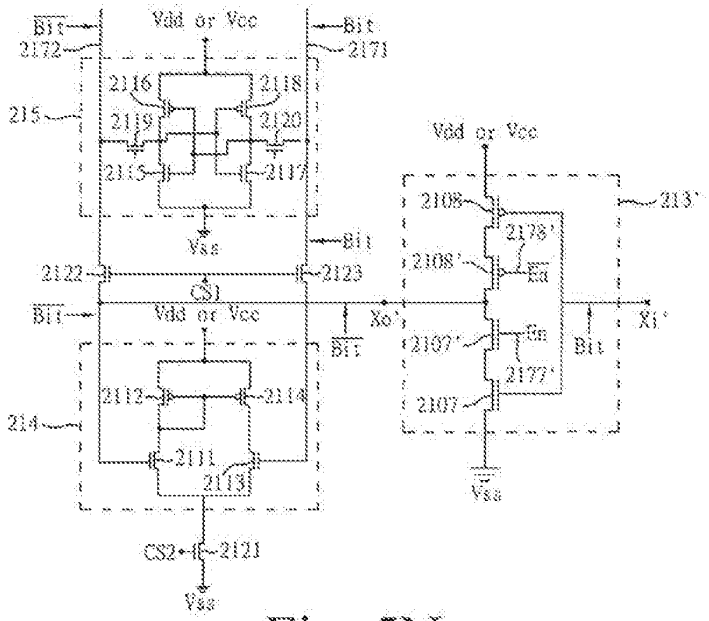

Bit
2172
Vdd or Vcc
Bit
2171
2116
2118
215
2119
2120
2115
2117
Vss
Bit
2122
2123
CS1
Bit
Vdd or Vcc
Xo'
Bit
2112
2114
214
2111
2113
CS2
2121
Vss
Vdd or Vcc
2108'
213'
2178'
2108'
En
2107'
Bit
Xi'
2177'
2107'
Vss

Fig. 5N

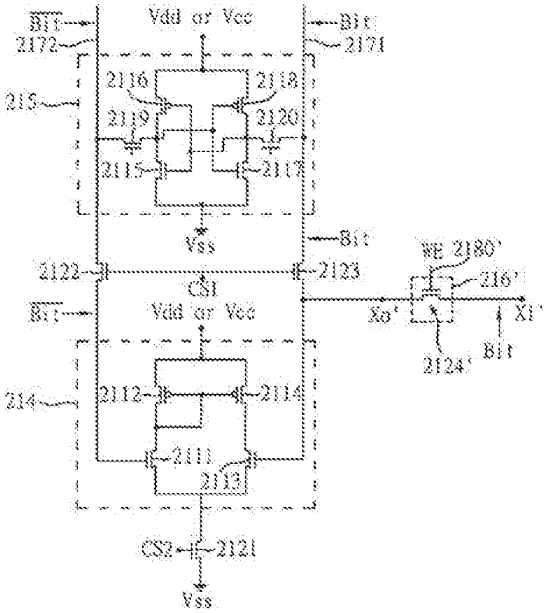

Bit
2172
Vdd or Vcc
Bit
2171
2116
2118
215
2119
2120
2115
2117
Vss
Bit
WE 2180'
2122
2123
CS1
216'
Bit
Vdd or Vcc
Xo'
Xi'
2124'
Bit
2112
2114
214
2111
2113
CS2
2121
Vss

Fig. 5O

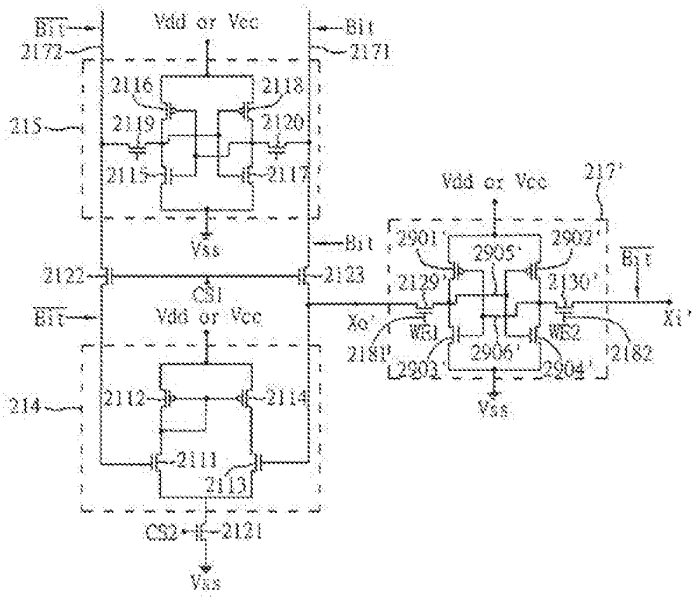

Bit
Vdd or Vcc
Bit
2172
2171
2116
2118
215
2119
2120
2115
2117
Vss
Bit
2122
2123
CS1
Vdd or Vcc
Bit
214
2112
2114
2111
2113
CS2
2121
Vss
Vdd or Vcc
217'
2901
2905'
2902'
Bit
2129
2130'
Xo'
WE1
WE2
Xi'
2181'
2182
2903'
2906'
2904'
Vss

Fig. 5P

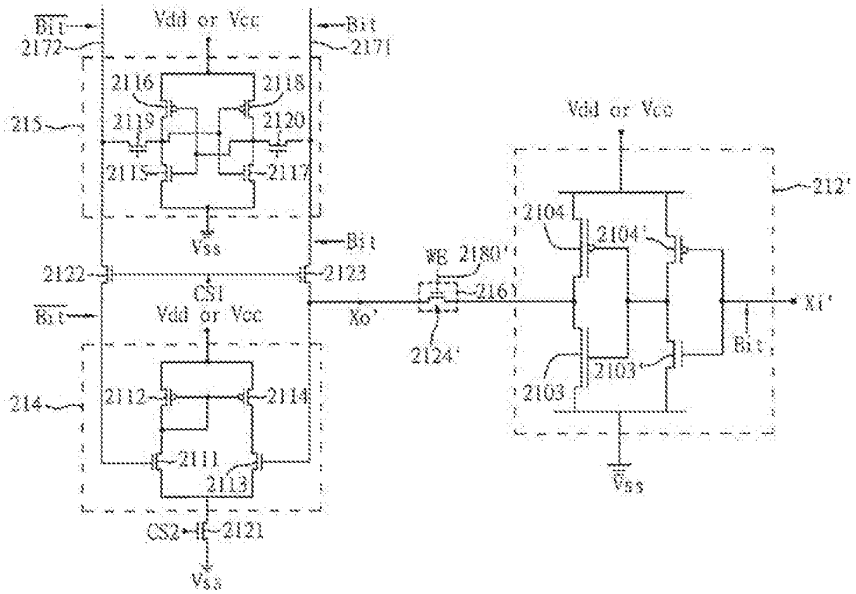

Bit
Vdd or Vcc
Bit
2172
2171
2116
2118
215
2119
2120
2115
2117
Vss
Bit
2122
2123
CS1
Vdd or Vcc
Bit
214
2112
2114
2111
2113
CS2
2121
Vss
Xo'
WE 2180'
216
2124'
Vdd or Vcc
212'
2104'
2104
Xi'
Bit
2103
2103'
Vss

Fig. 5Q

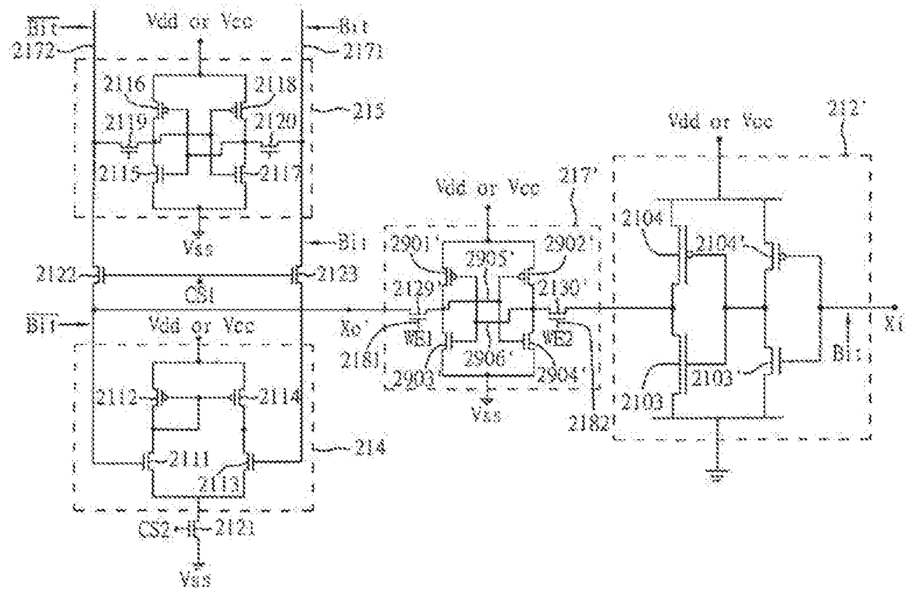

Vdd or Vcc
Bit
2172
2171
2116
2118
2119
2120
215
2115
2117
Vss
2122
2123
CS1
Xo'
2112
2114
2111
2113
214
CS2
2121
Vss
217'
2901'
2902'
2905'
2129'
2130'
WE1
WE2
2181
2906'
2903'
2904'
2182
212'
2104
2104'
2103
2103'
Xi'
Bit

Fig. 5R

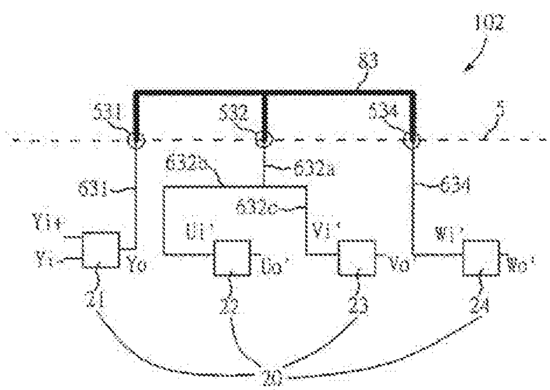

102
83
531
532
534
5
631
632b
632a
634
632c
Yi+
Yi
Yo
Ui'
Uo'
Vi'
Vo'
Wi'
Wo'
21
22
23
24
30

Fig. 5S

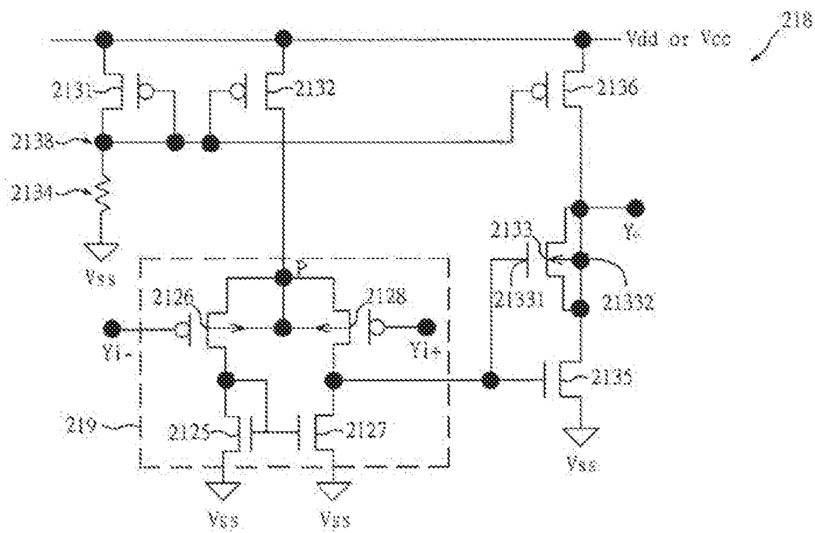

218
Vdd or Vcc
2131
2132
2136
2138
2134
Vss
2133
Yo
21331
21332
2126
2128
Yi-
Yi+
2135
219
2125
2127
Vss
Vss
Vss

Fig. 5T

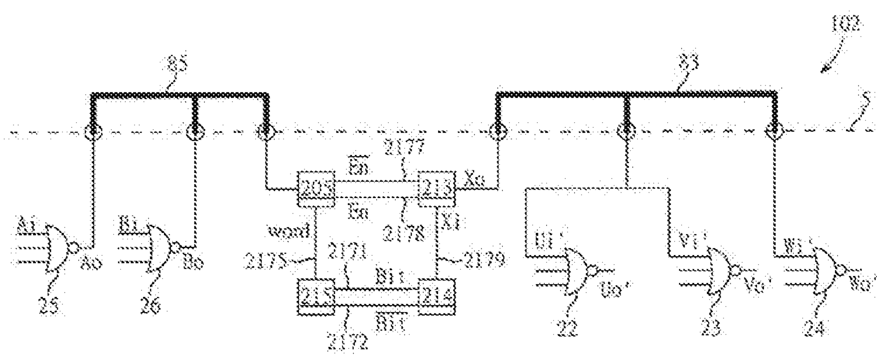

102
85
83
5
2177
En
205
213
Xo
En
Xi
word
2178
2175
2171
2179
Bit
215
214
Bit
2172
Ai
Ao
Bi
Bo
25
26
Ui'
Uo'
Vi'
Vo'
Wi'
Wo'
22
23
24

Fig. 5U

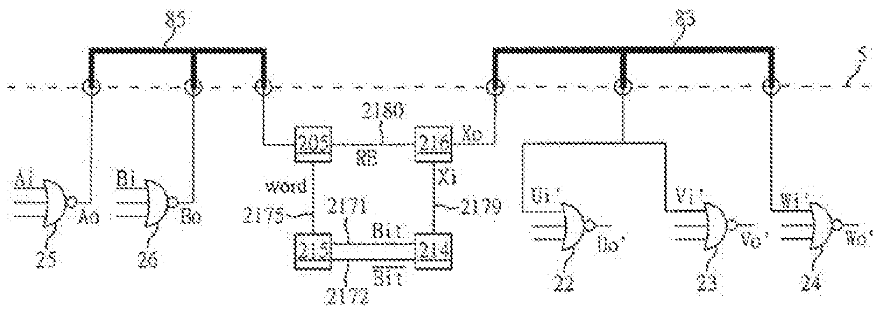

85
83
5
2180
205
RE
216
Xo
word
Xi
Ai
Bi
Ui'
Vi'
Wi'
2175
2171
2179
Bit
Ao
Bo
Uo'
Vo'
Wo'
215
214
Bit
25
26
2172
22
23
24

Fig. 5V

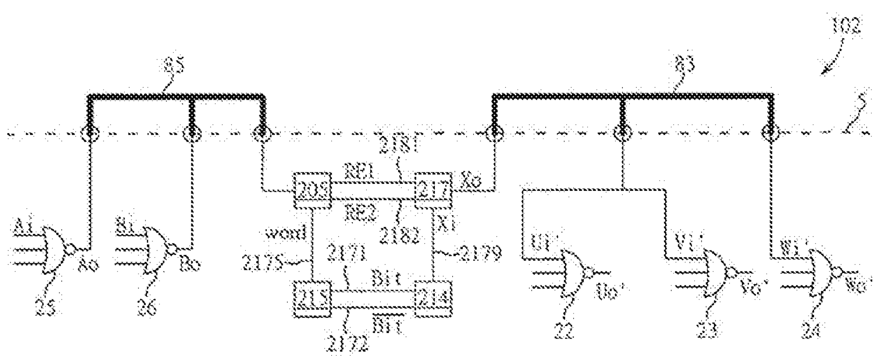

102
85
83
5
2181
205
RE1
217
Xo
RE2
2182
word
Xi
Ai
Bi
Ui'
Vi'
Wi'
2175
2171
2179
Bit
Ao
Bo
Uo'
Vo'
Wo'
215
214
Bit
25
26
2172
22
23
24

Fig. 5W

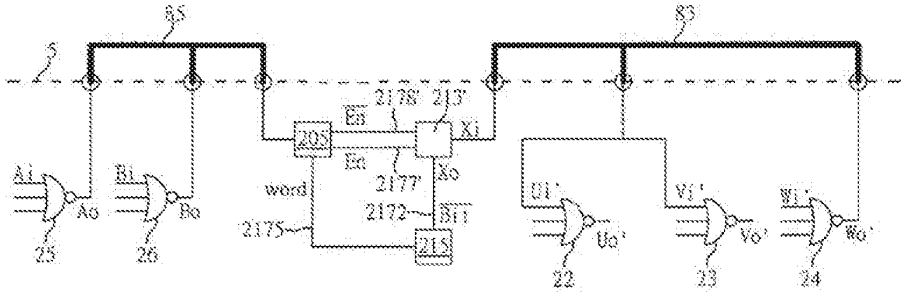

85
83
S
2178'
217'
En
205
Xi
Eo
2177'
Xo
word
2172
Bit
2175
215
Ai
Bi
Ao
Bo
25
26
Ui'
Vi'
Wi'
Uo'
Vo'
Wo'
22
23
24

Fig. 5X

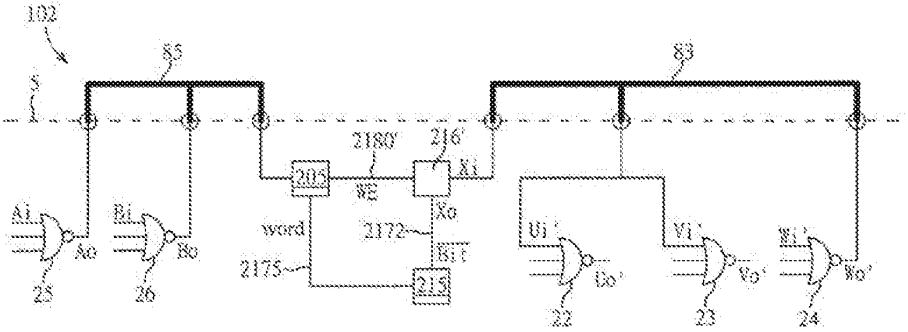
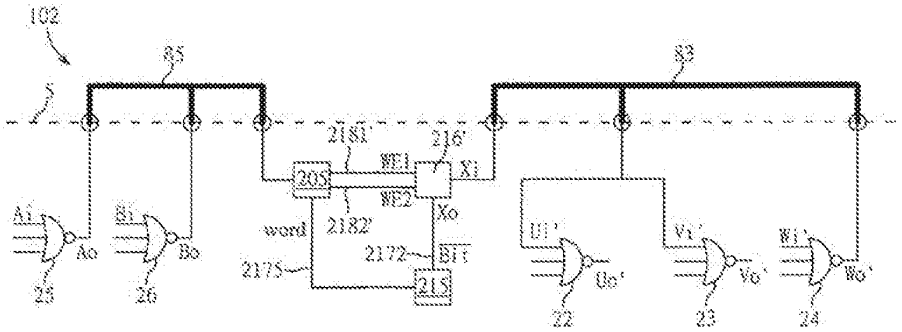

102
85
83
S
2180'
216'
205
Xi
We
Xo
word
2172
Bit
2175
215
Ai
Bi
Ao
Bo
25
26
Ui'
Vi'
Wi'
Uo'
Vo'
Wo'
22
23
24

Fig. 5Y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85
83
2181'
216'
205
WE1
WE2
Xi
Xo
word
2182'
2172
BIT
215
2175
Ai'
Ao
Bi'
Bo
25
26
Ui'
Uo'
Vi'
Vo'
Wi'
Wo'
22
23
24

Fig. 5Z

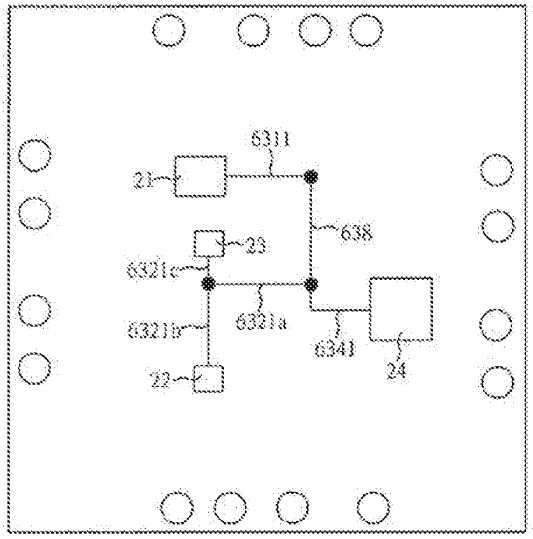
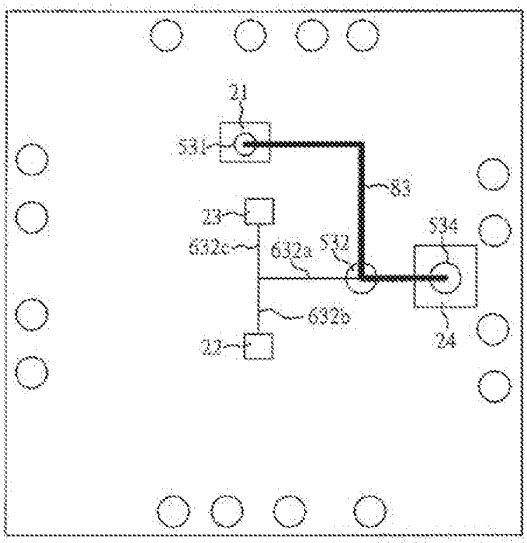

6311
21
638
23
6321c
6321a
6321b
6341
24
22

Fig. 6A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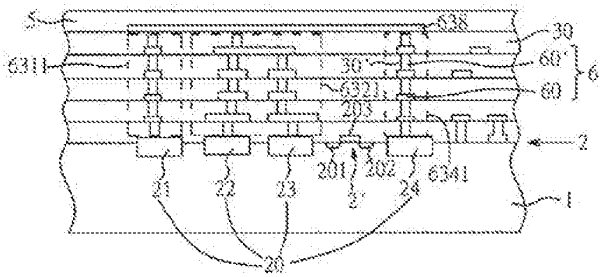
632c
632a
532
632b
22
24

Fig. 6B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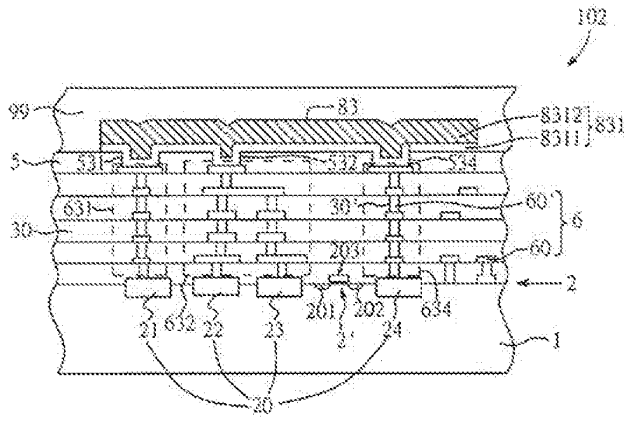
638
30
631
60
6
30
60
6321
203
2
201
202
6341
21
22
23
24
1
20

Fig. 7A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8311
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534
631
30'
60'
6
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2031
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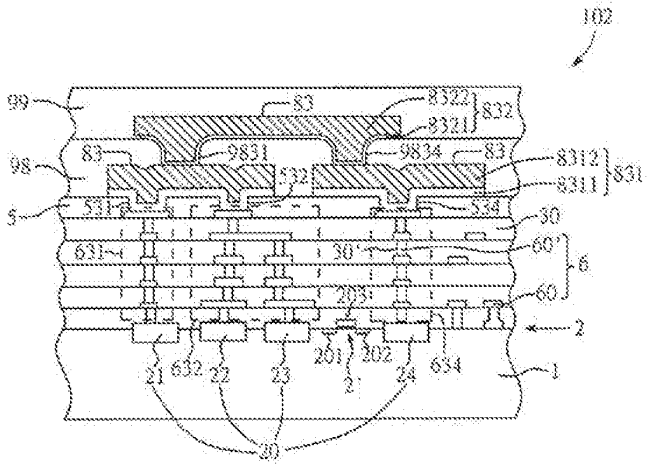
2
201
202
634
21
632
22
23
24
1
20

Fig. 7B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8311
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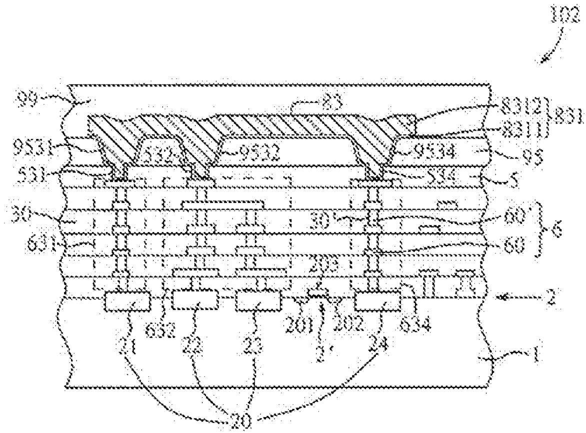
5
531
532
534
30
631
30'
60'
6
2031
60
2
201
202
634
21
632
22
23
24
1
20

Fig. 7C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9532
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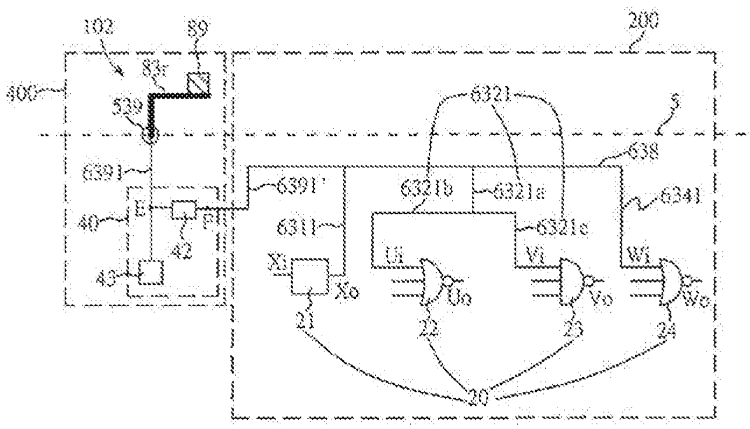
95
531
534
5
30
30'
60'
6
631
60
203
2
632
201
202
634
21
22
23
2'
24
1
20

Fig. 7D


102
89
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83r
400
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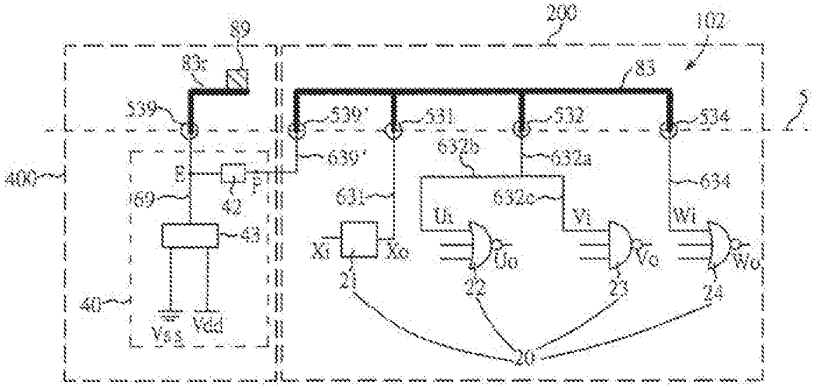
6321
5
638
6391
6391'
6321b
6321a
6341
40
E
42
F
6311
6321c
Ui
Vi
Wi
Xi
Xo
Uo
Vo
Wo
43
21
22
23
24
20

Fig. 8A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102
83c
83
539
539'
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532
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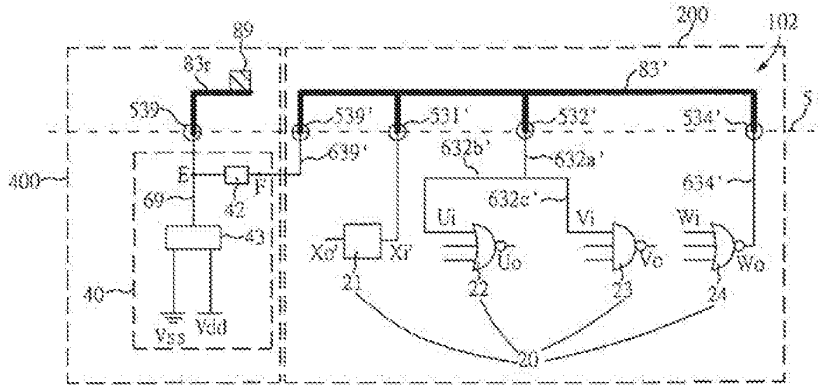
639'
632b
632a
400
69
42
631
632c
634
Ui
Vi
Wi
Xi
Xo
Uo
Vo
Wo
43
21
22
23
24
40
Vss
Vdd
20

Fig. 8B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200
102
83c
83'
539
539'
531'
532'
534'
639'
632b'
632a'
400
69
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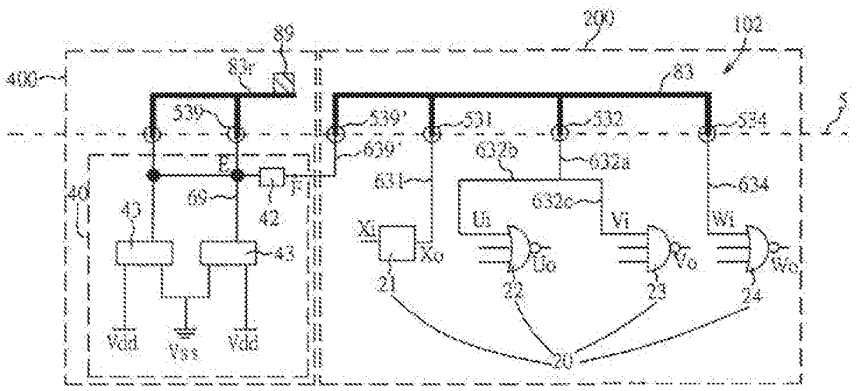
632c'
634'
Ui
Vi
Wi
Xi'
Xo'
Uo
Vo
Wo
43
21
22
23
24
40
Vss
Vdd
20

Fig. 8C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200
102
400
83r
83
539
539'
531
532
534
5
639'
632b
632a
631
634
40
69
42
632c
Ui
Vi
Wi
Xi
Xo
Uo
Vo
Wo
43
21
22
23
24
Vdd
Vss
20

Fig. 8D

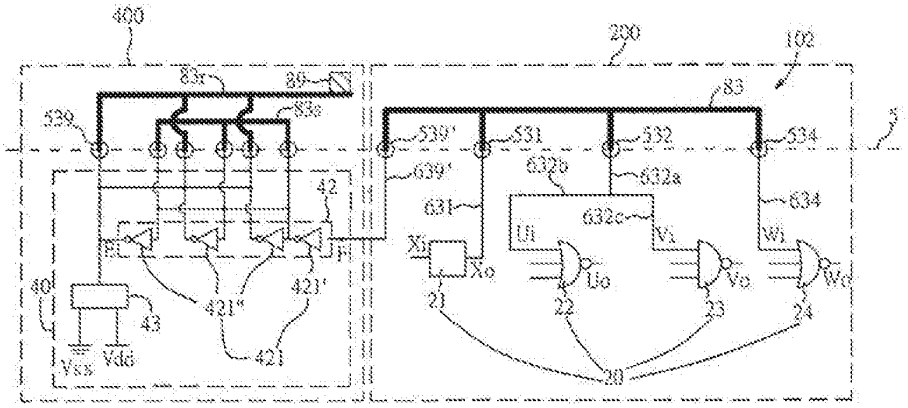
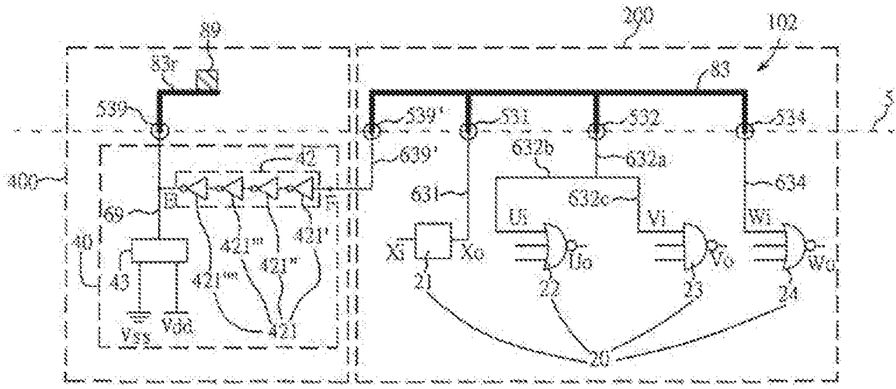

400
200
102
83r
86
83s
83
539
539'
531
532
534
5
639'
632b
632a
631
634
42
632c
Ui
Vi
Wi
Xi
Xo
Uo
Vo
Wo
40
43
421"
423'
421
21
22
23
24
Vss
Vdd
20

Fig. 8E


200
102
89
83r
83
539
539'
531
532
534
5
400
639'
632b
632a
42
69
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632c
Ui
Vi
Wi
40
Xi
Xo
Uo
Vo
Wo
43
421'''
421''
421'
421''''
21
22
23
24
Vss
Vdd
421
20

Fig. 8F

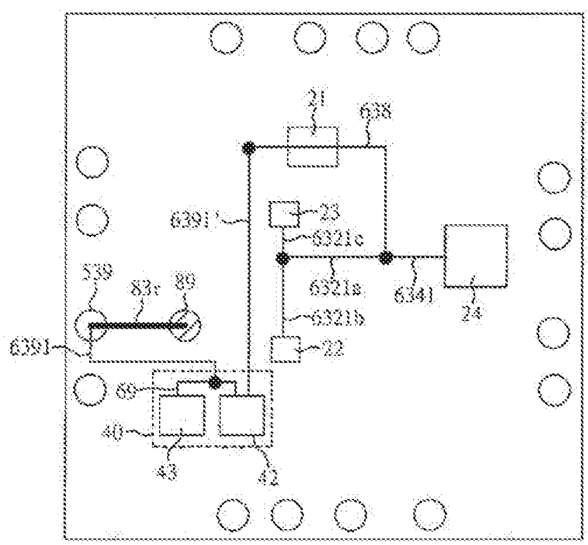

21
638
6391'
23
6321c
6321a
6341
24
6321b
539
83r
89
6391
22
69
40
43
42

Fig. 9A

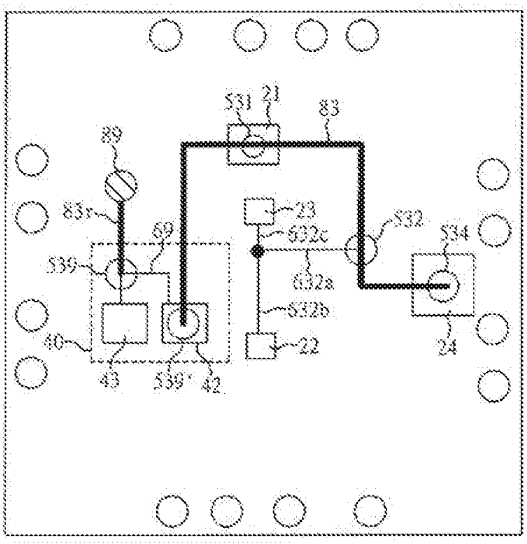
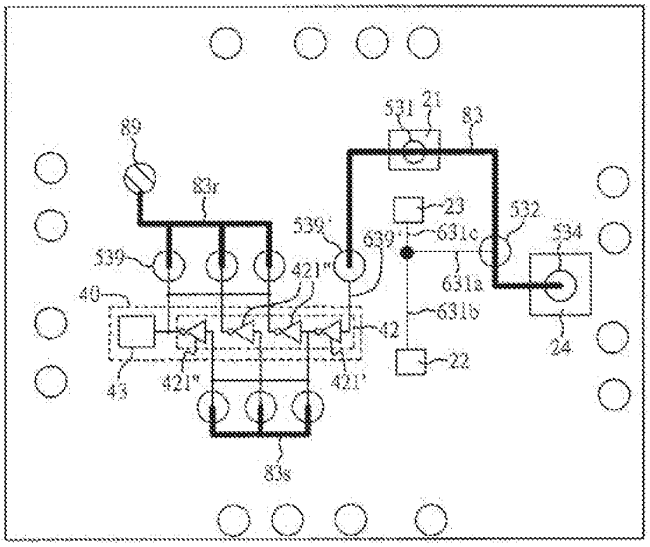

531
21
83
89
83r
23
632c
532
534
539
69
632a
632b
40
22
24
43
539'
42

Fig. 9B


531
21
83
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83r
23
539'
631c
532
534
539
631a
421"
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631b
42
22
24
43
421"
421'
83s

Fig. 9C

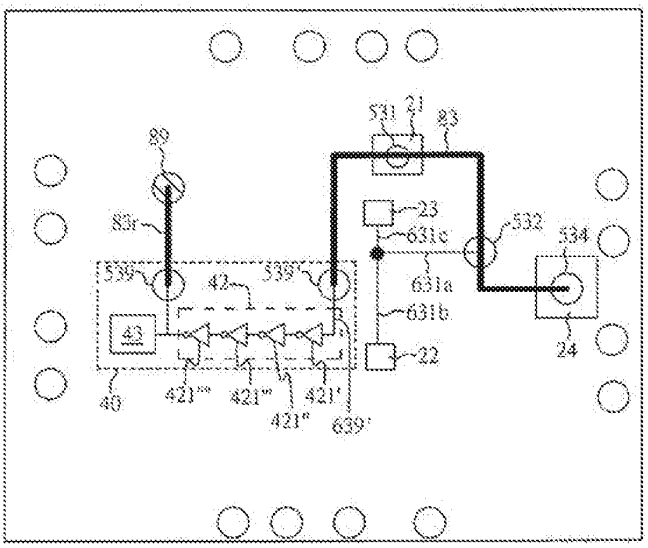


Fig. 9D

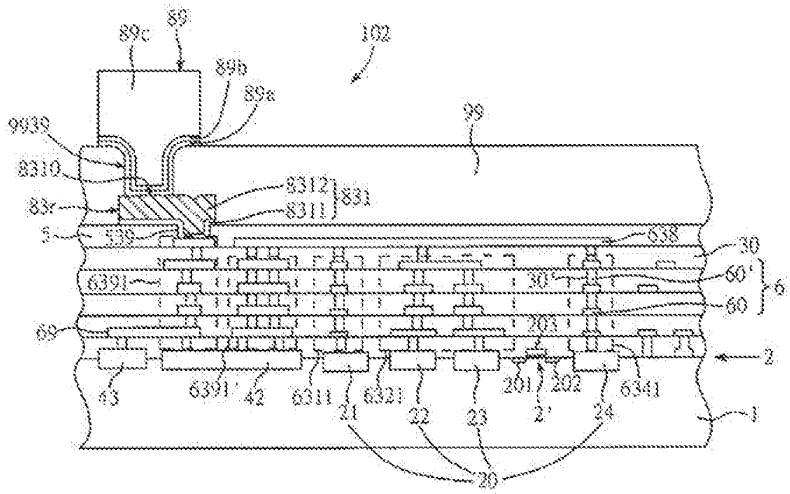


Fig. 10A

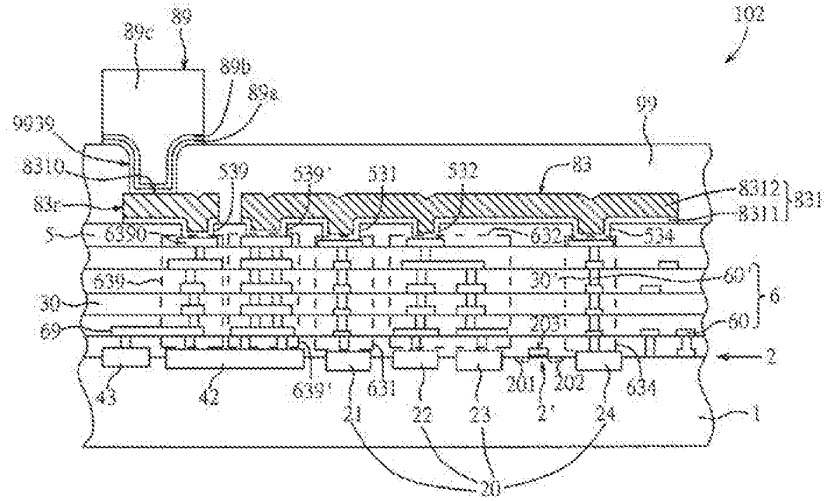


Fig. 10B

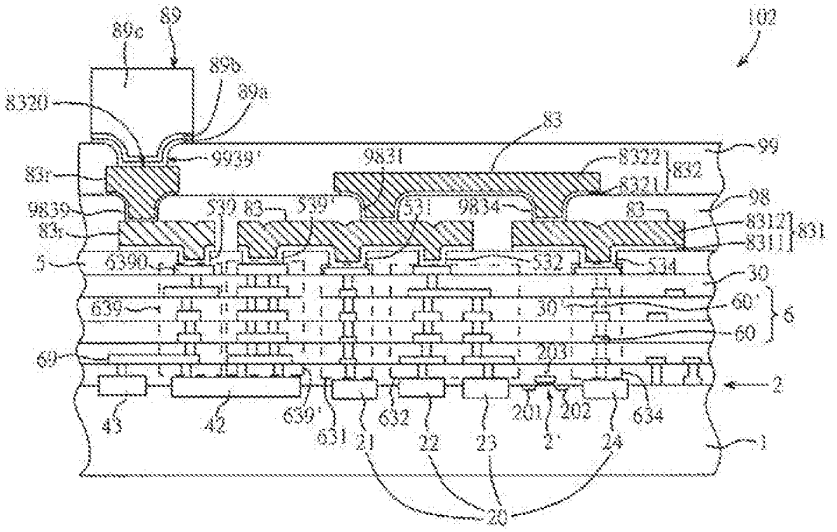


Fig. 10C

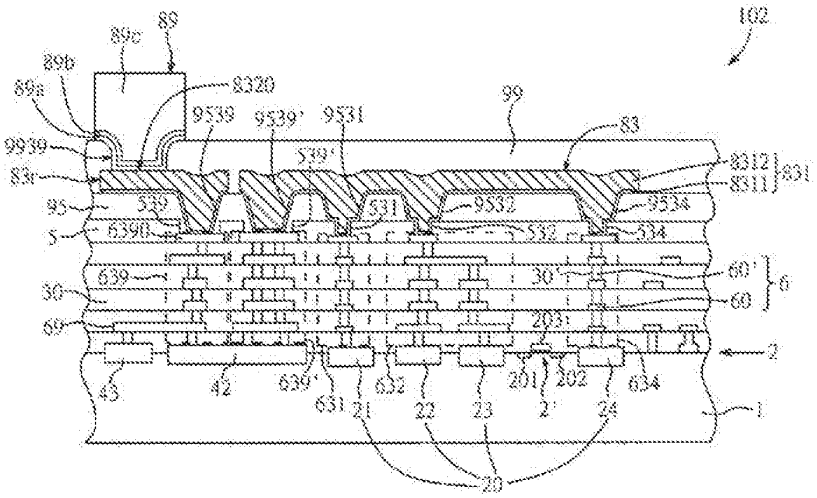


Fig. 10D

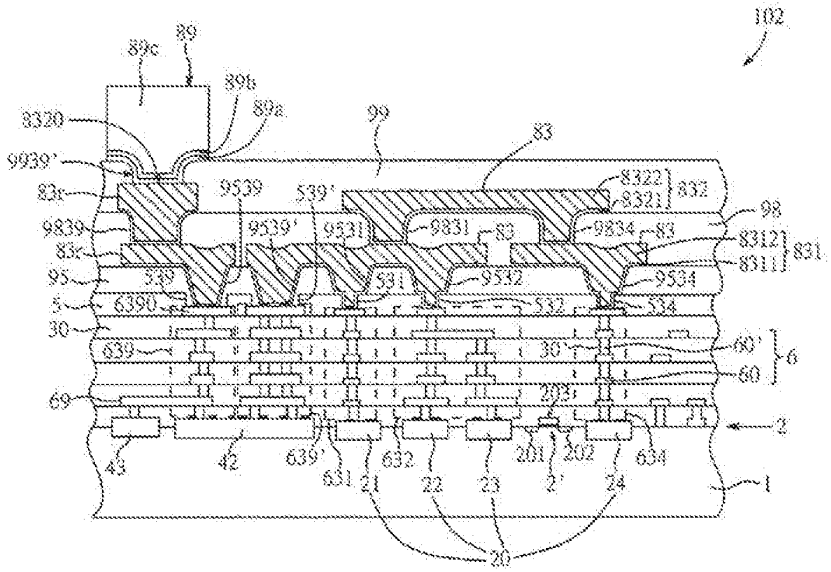


Fig. 10E

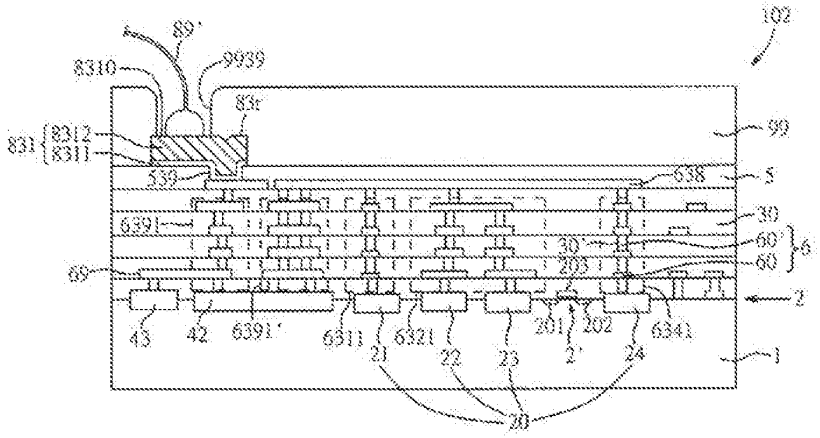


Fig. 10F

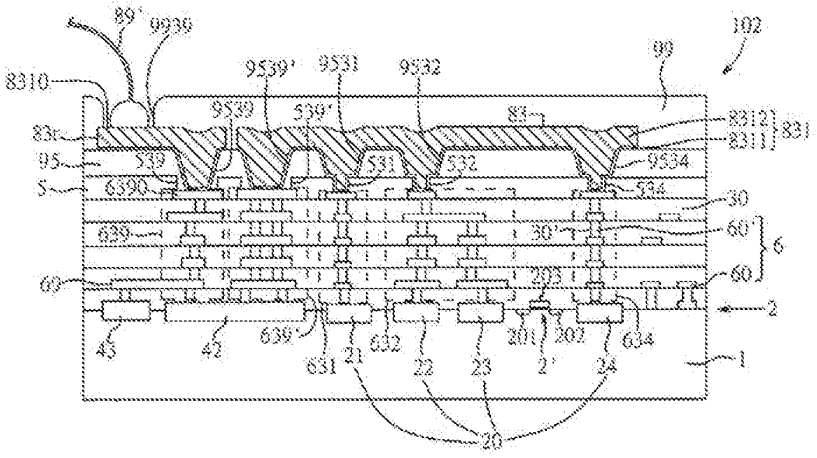


Fig. 10G

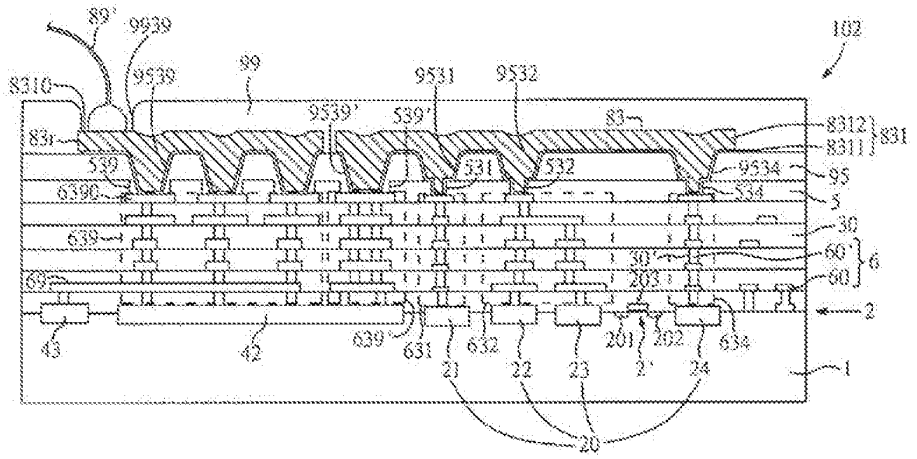


Fig. 10H

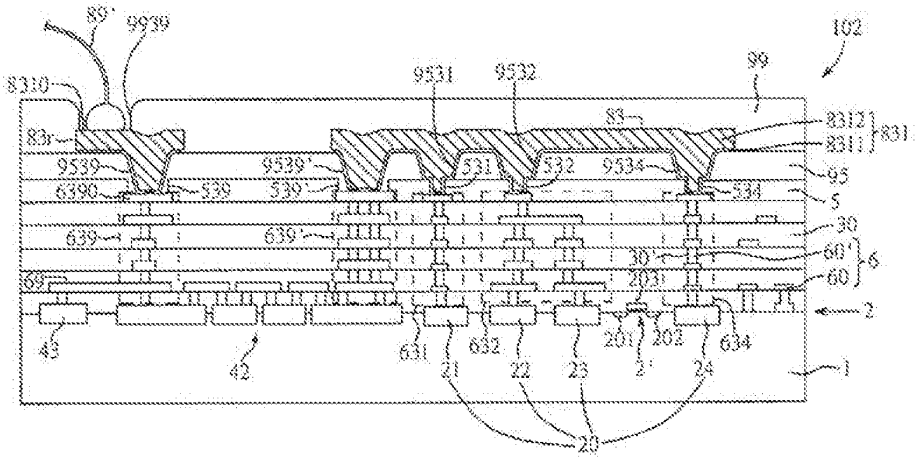


Fig. 10I

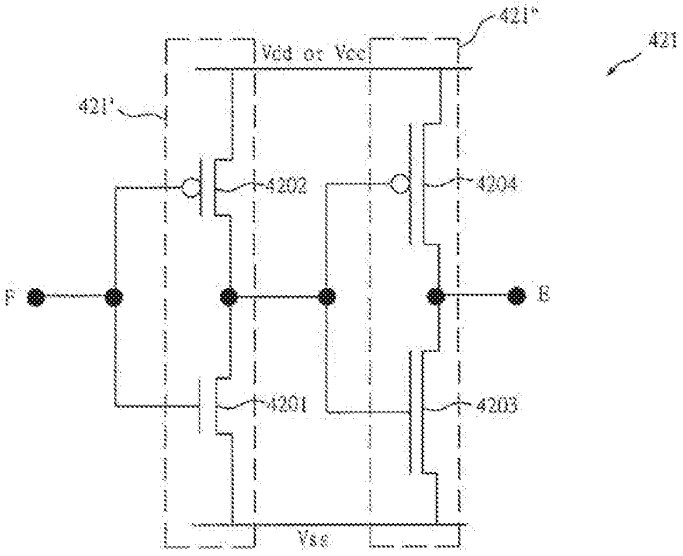


Fig. 11A

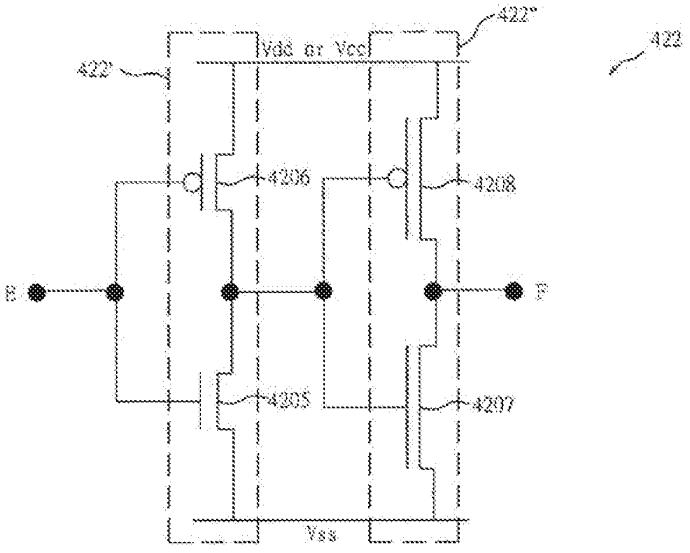


Fig. 11B

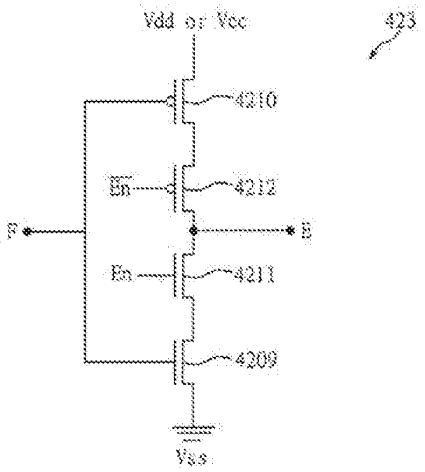


Fig. 11C

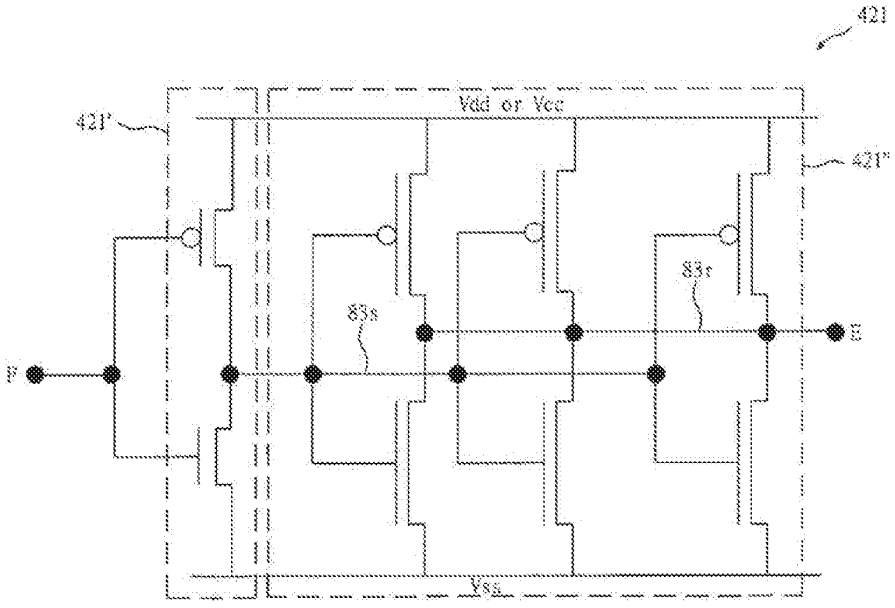


Fig. 11D

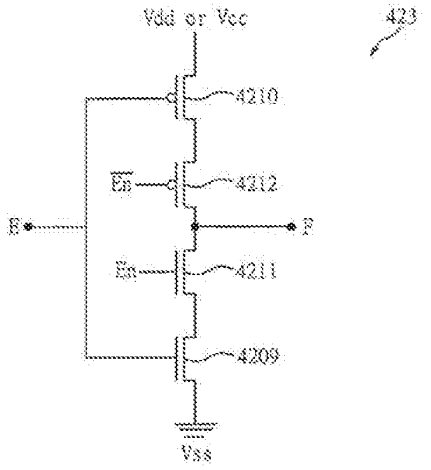


Fig. 11E

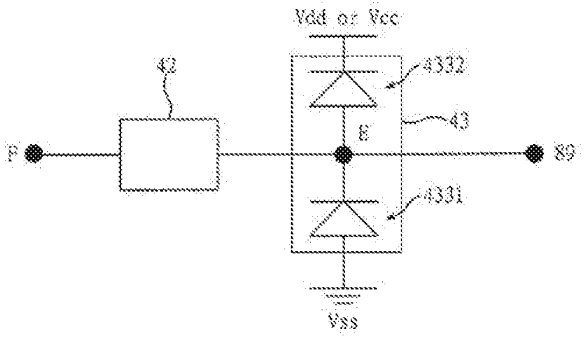


Fig. 11F

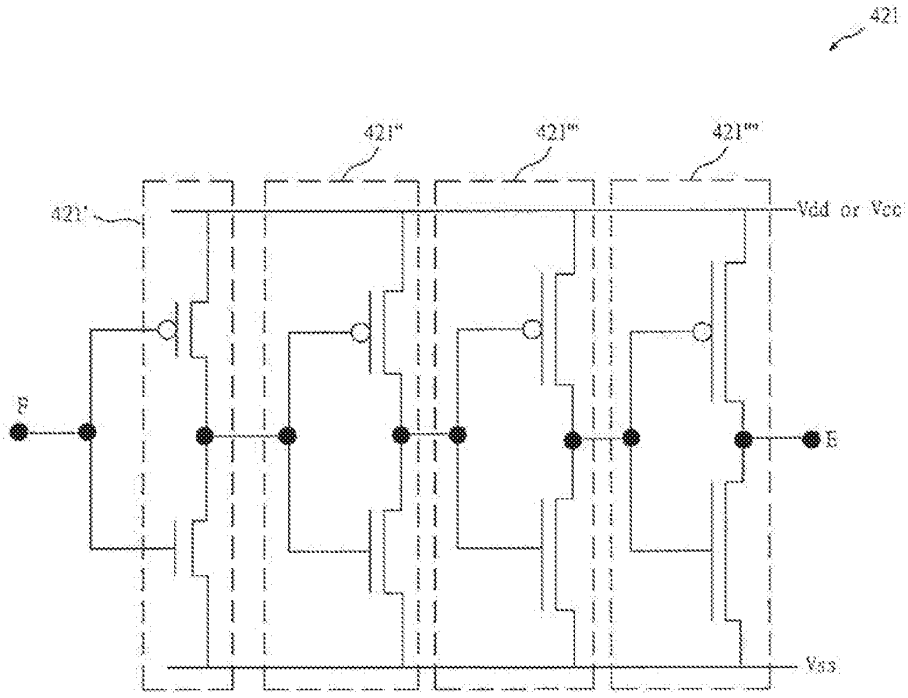


Fig. 11G

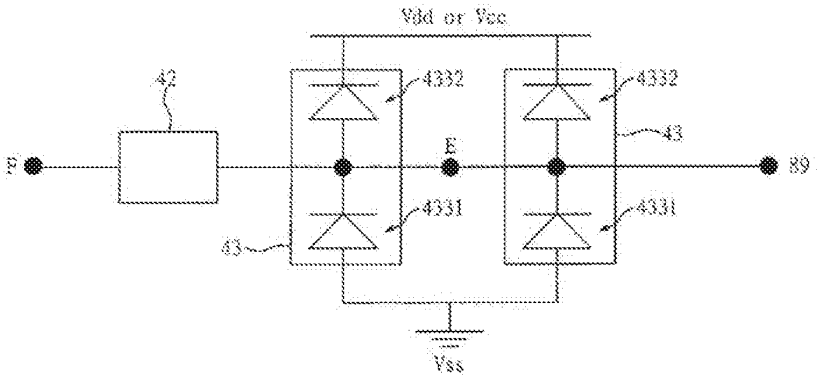


Fig. 11H

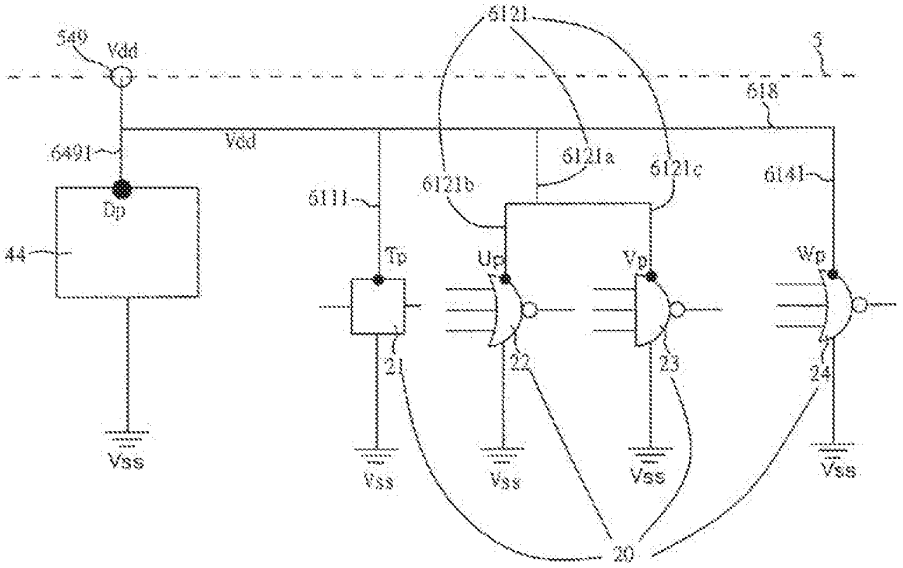


Fig. 12A

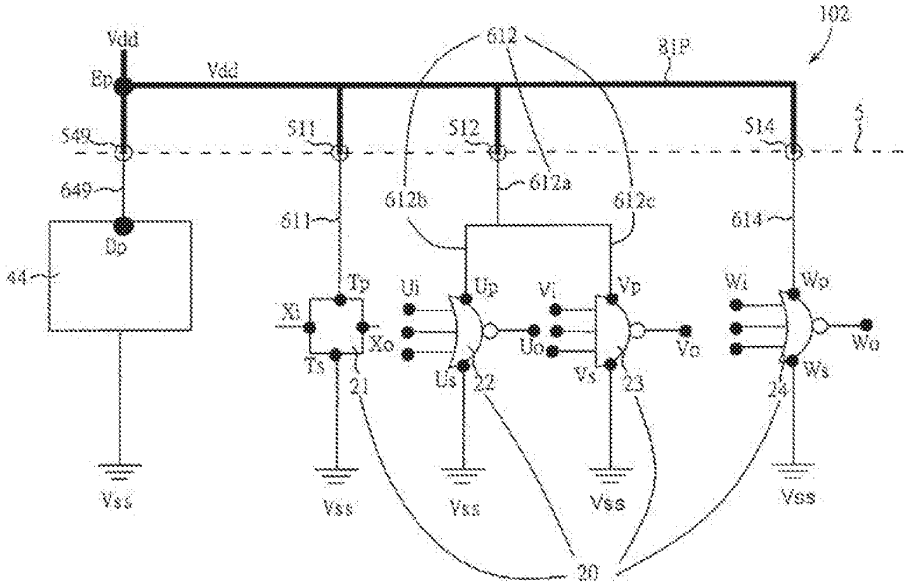


Fig. 12B

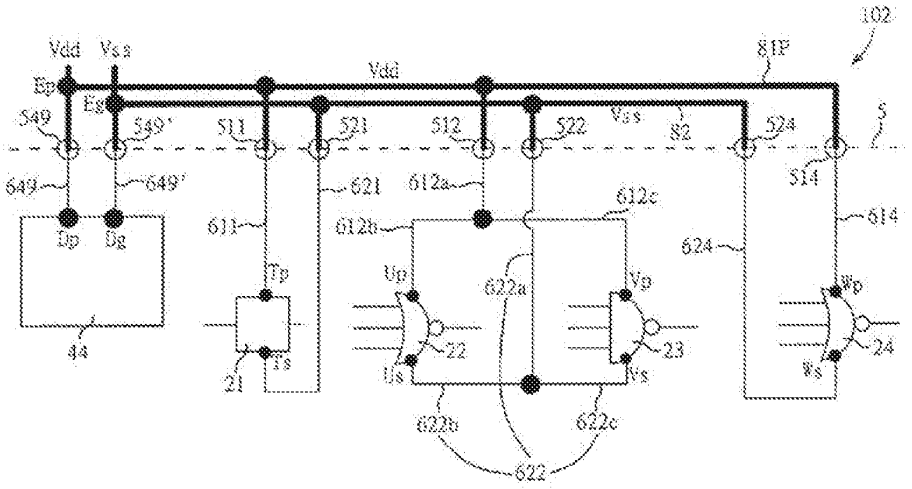


Fig. 12C

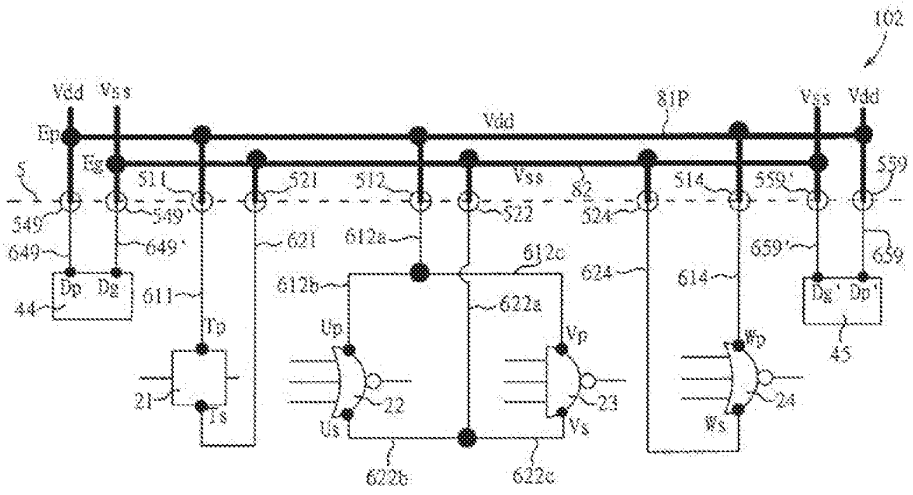


Fig. 12D

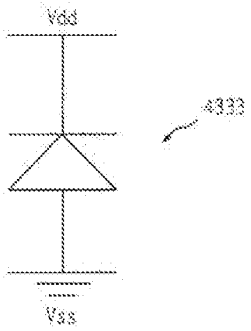


Fig. 12E

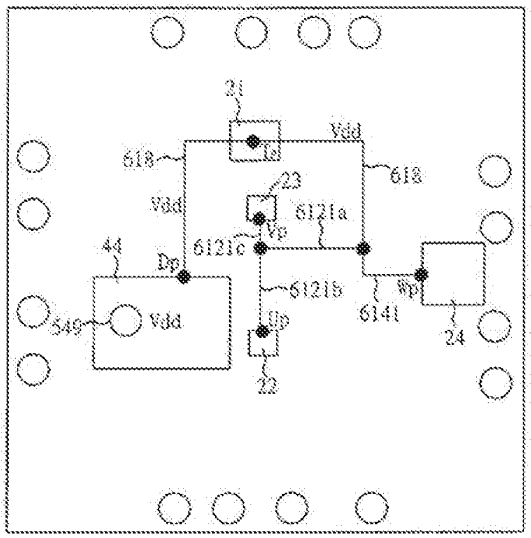


Fig. 13A

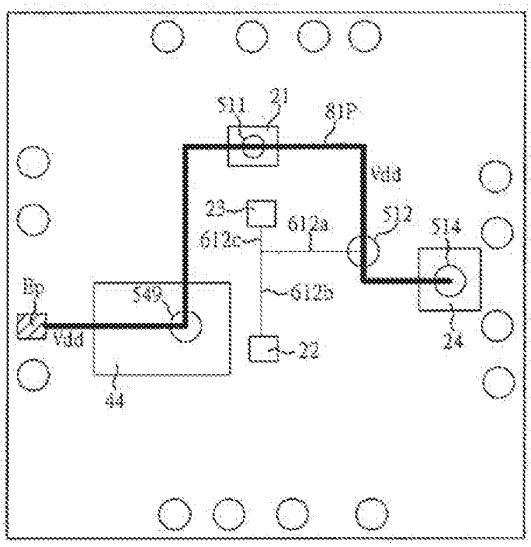


Fig. 13B

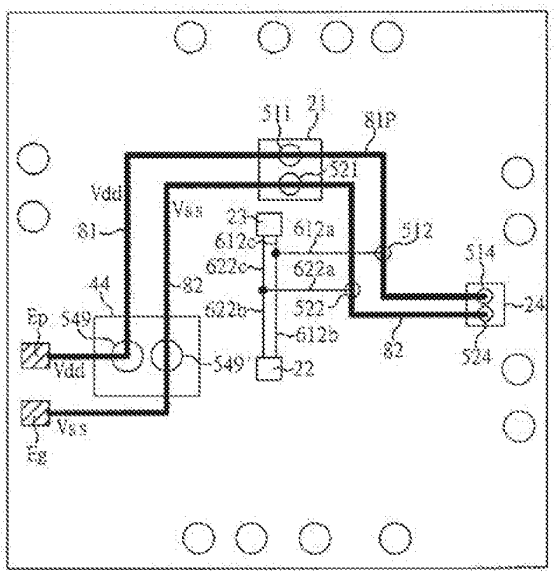


Fig. 13C

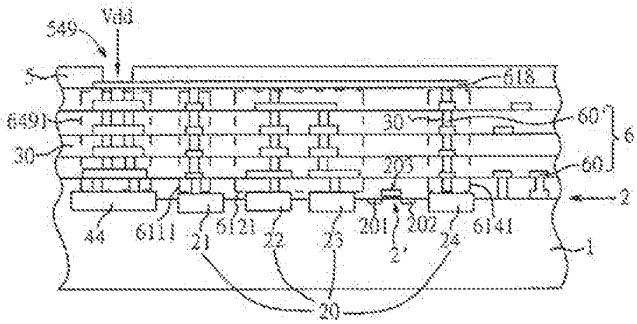


Fig. 14A

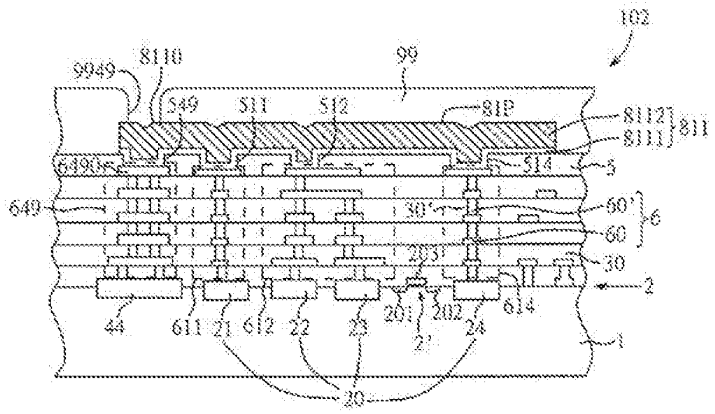


Fig. 14B

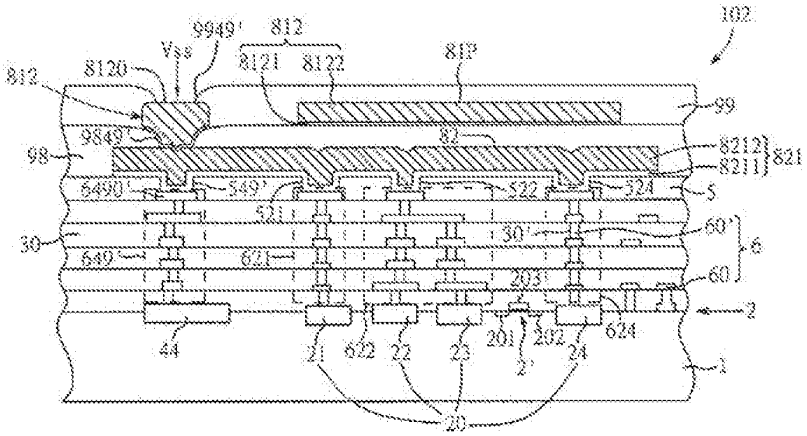


Fig. 14C

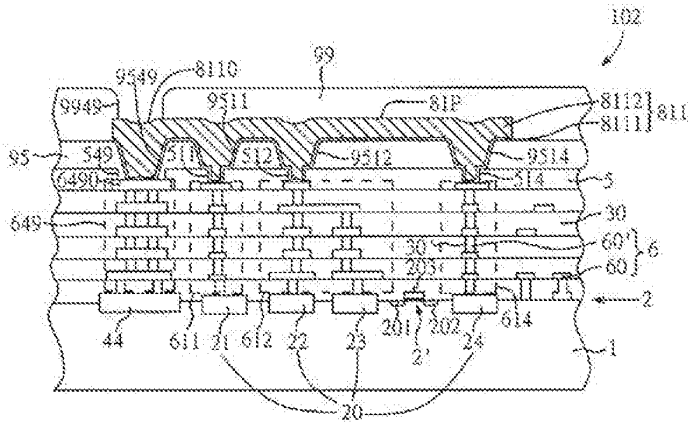


Fig. 14D

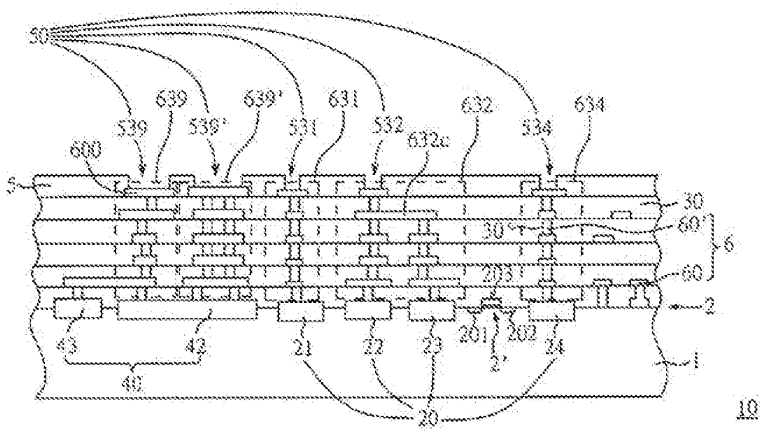


Fig. 15A

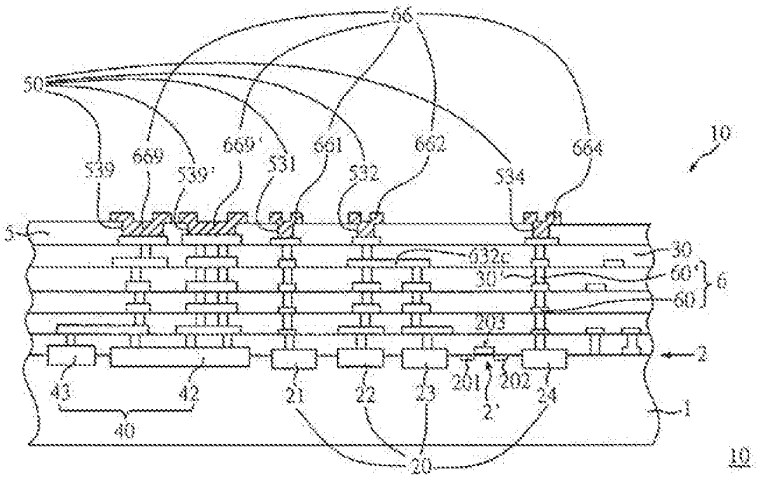


Fig. 15B

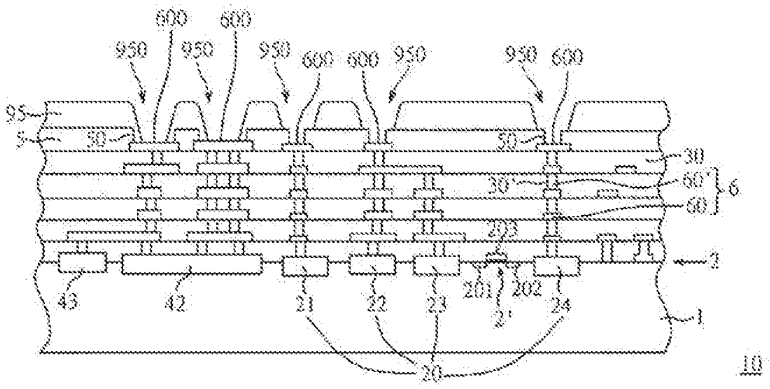


Fig. 15C

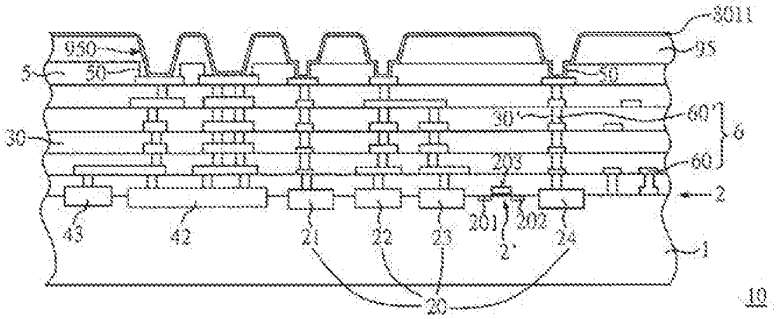


Fig. 15D

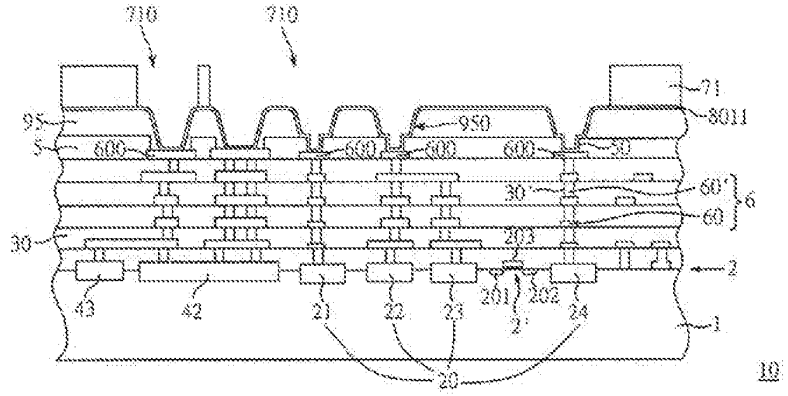


Fig. 15E

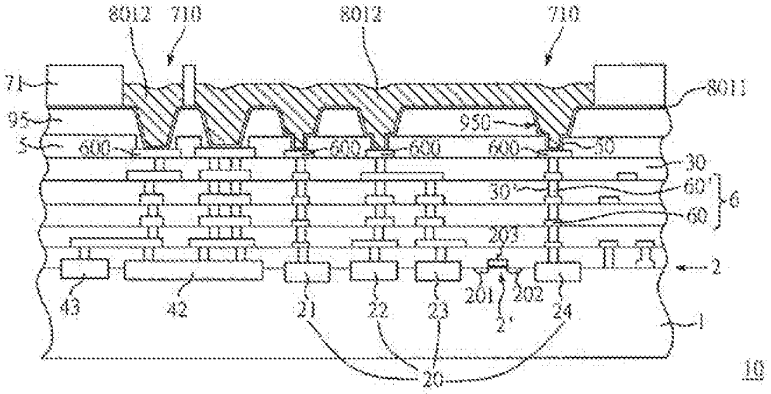


Fig. 15F

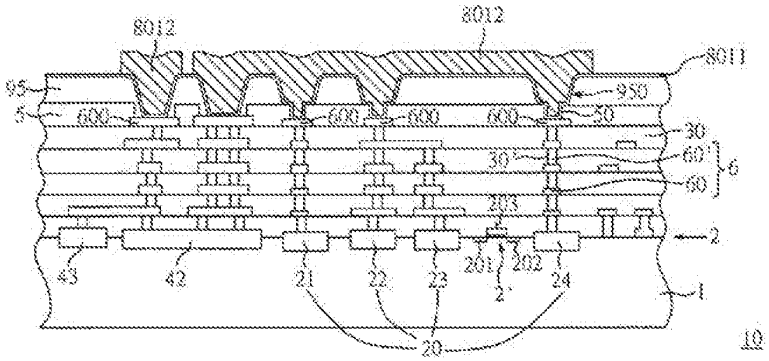


Fig. 15G

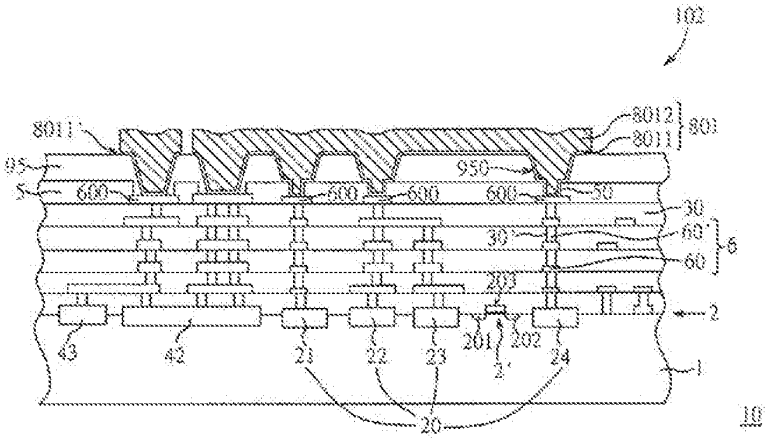


Fig. 15H

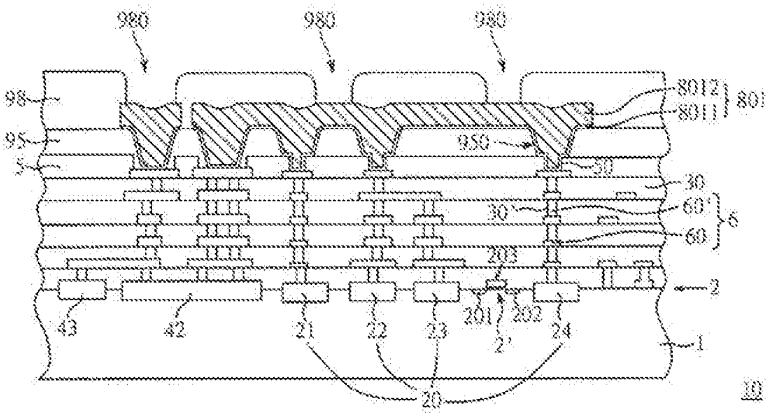


Fig. 15I

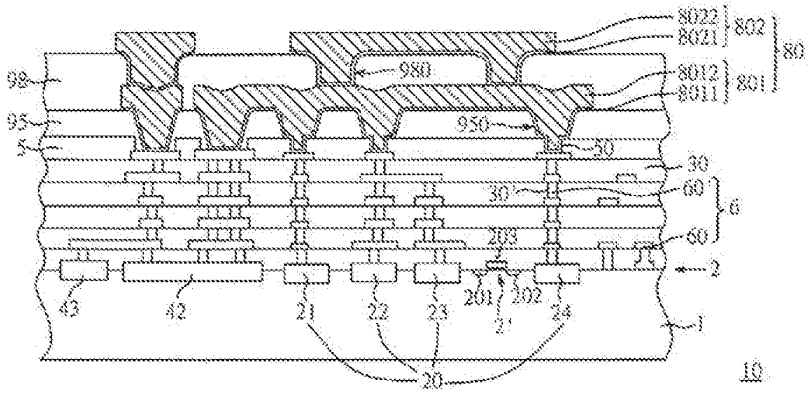


Fig. 15J

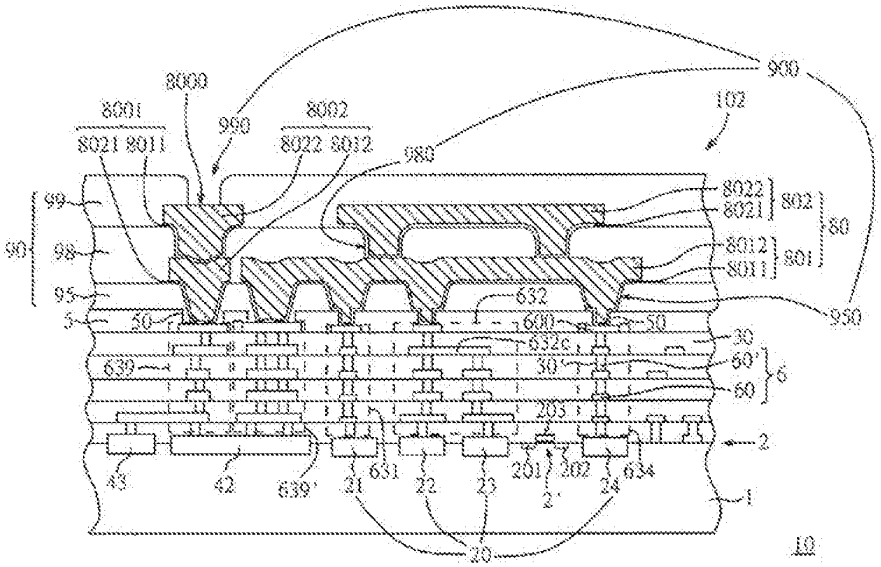


Fig. 15K

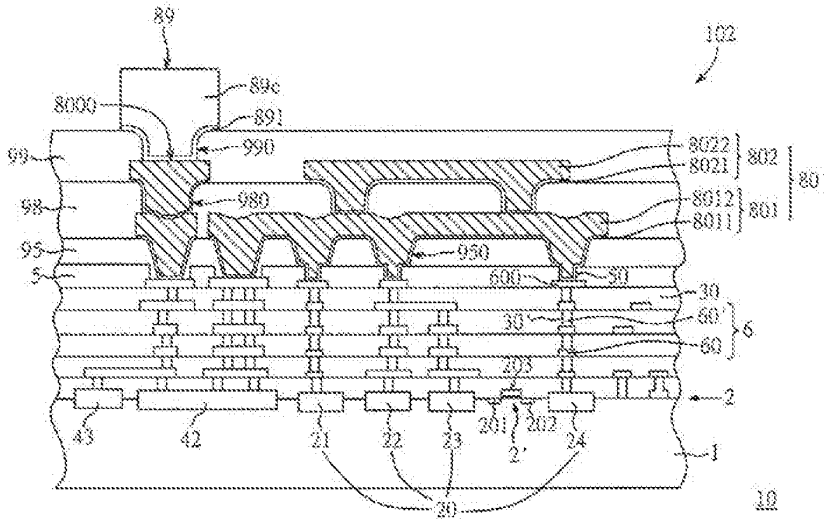


Fig. 15L

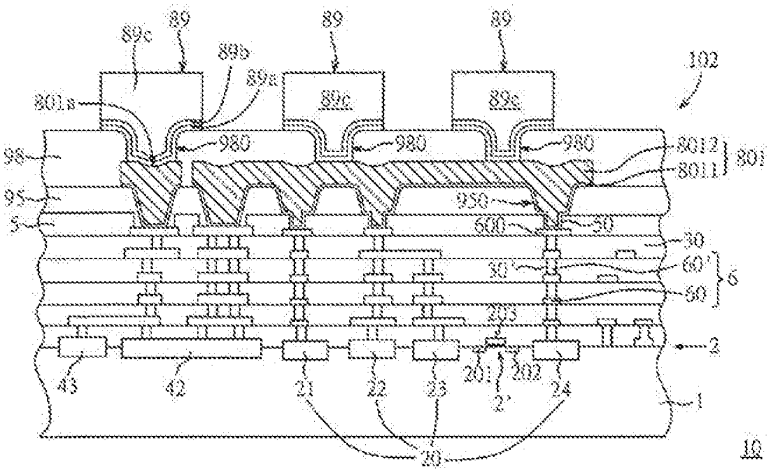


Fig. 15M

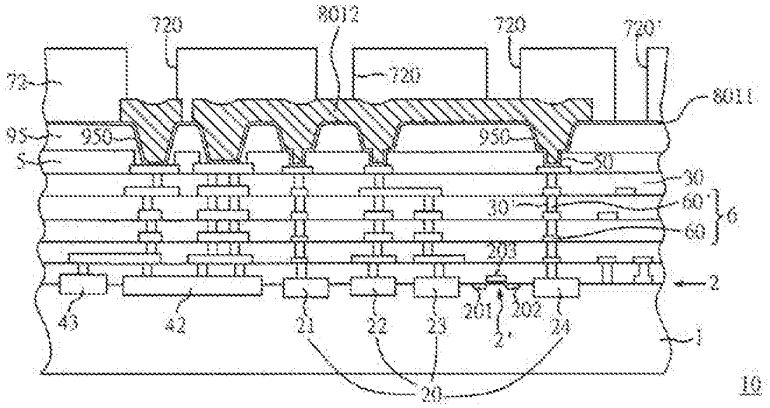


Fig. 16A

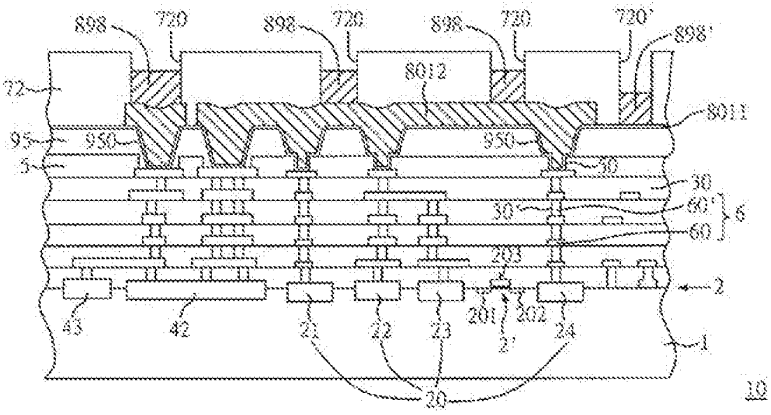


Fig. 16B

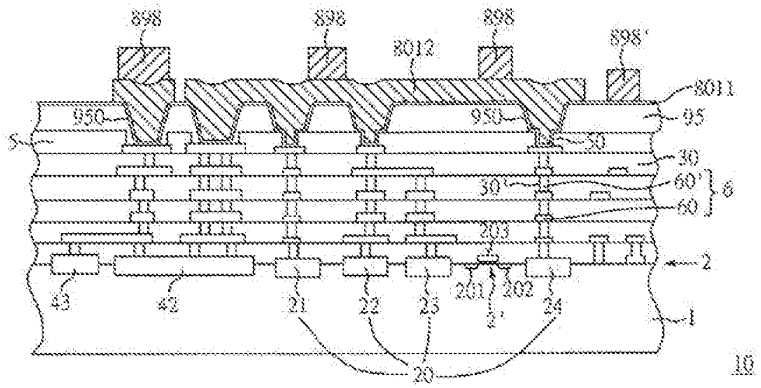


Fig. 16C

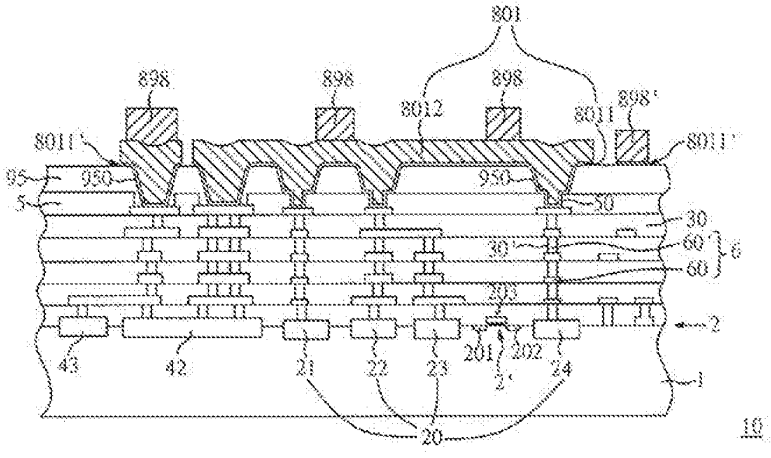


Fig. 16D

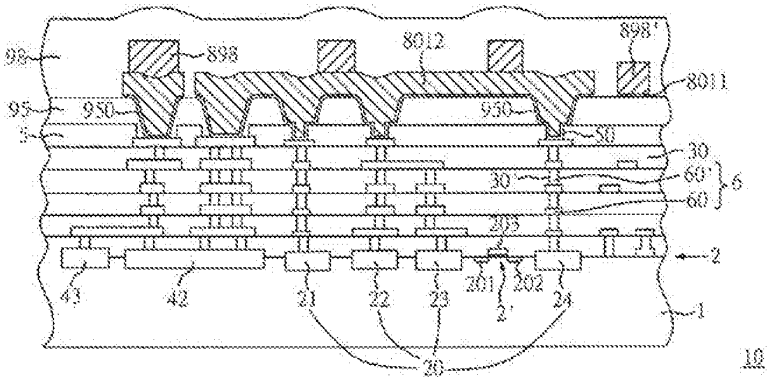


Fig. 16E

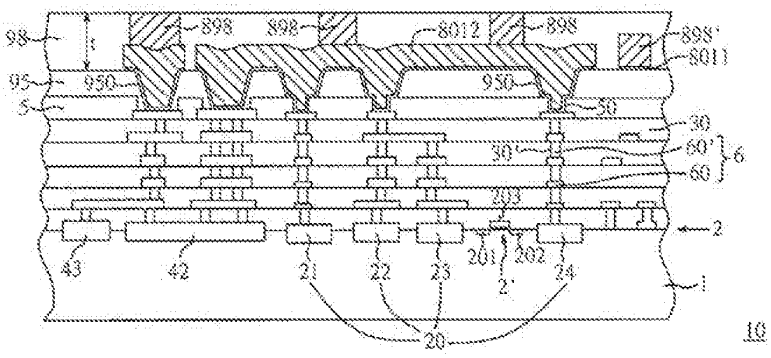


Fig. 16F

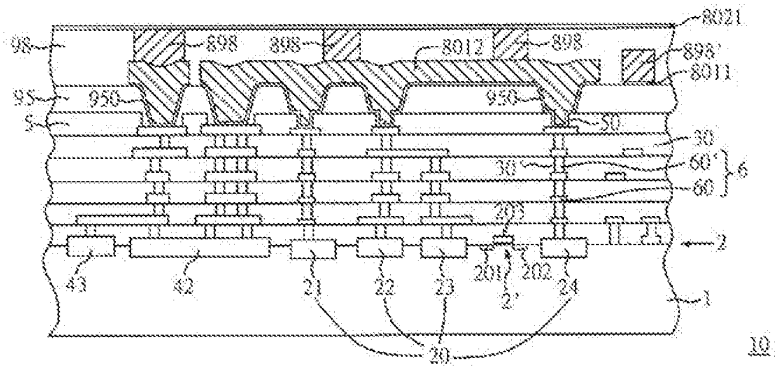


Fig. 16G

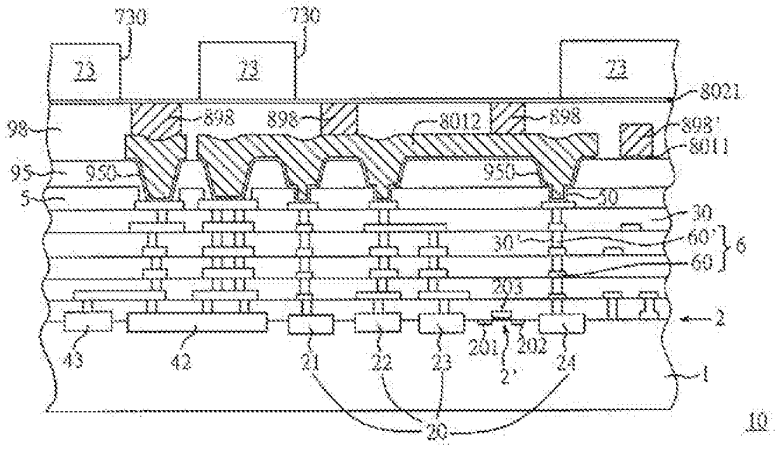


Fig. 16H

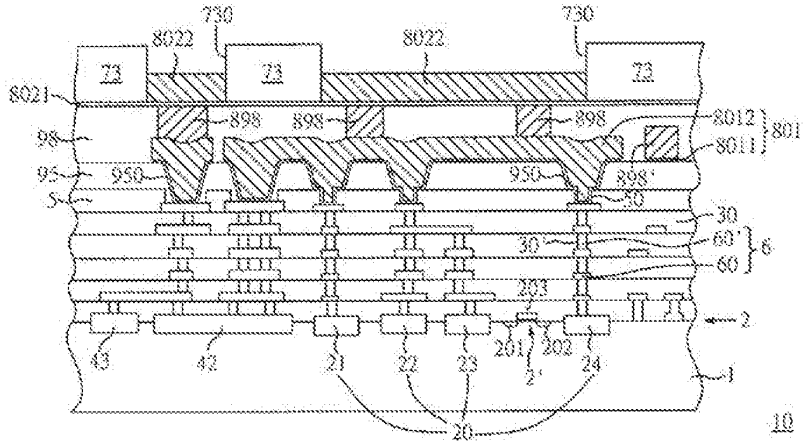


Fig. 16I

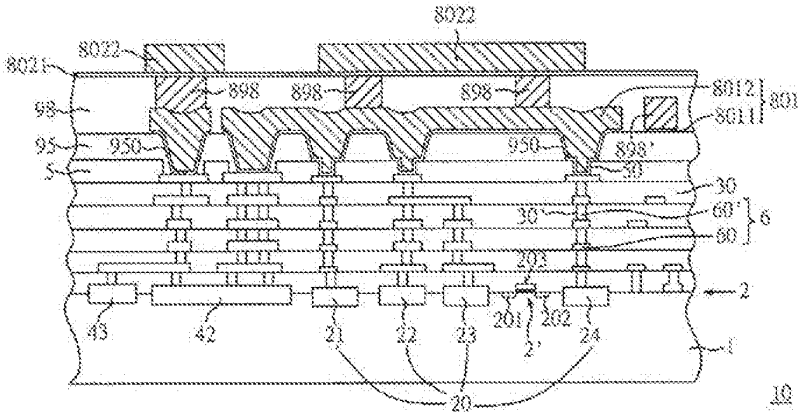


Fig. 16J

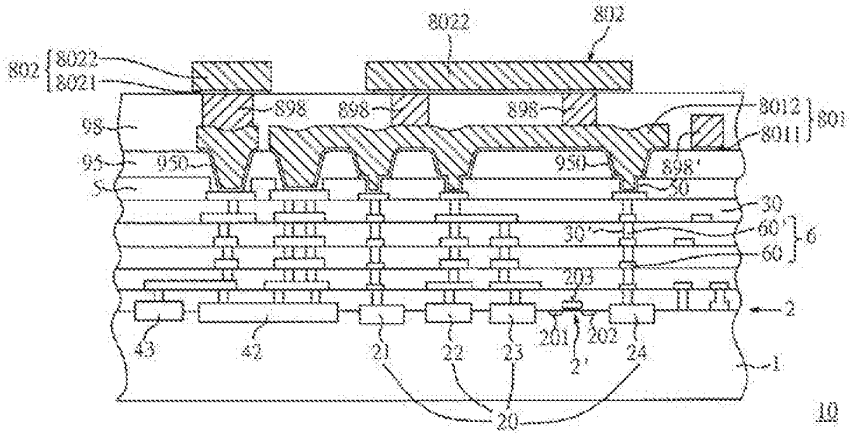


Fig. 16K

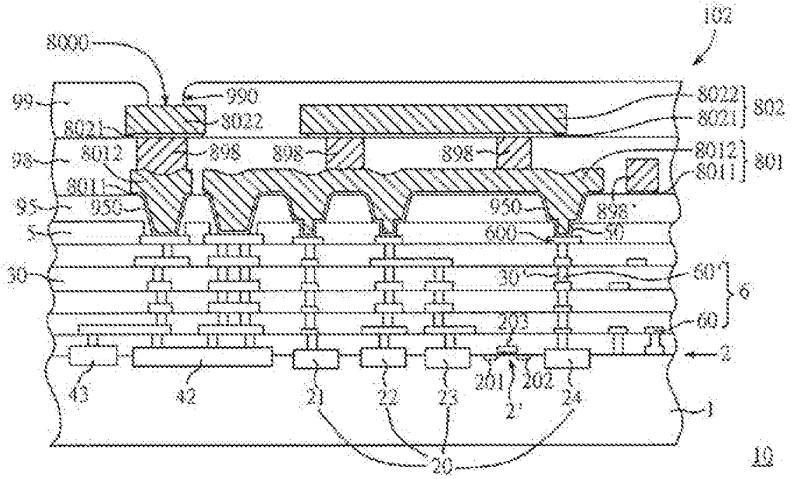


Fig. 16L

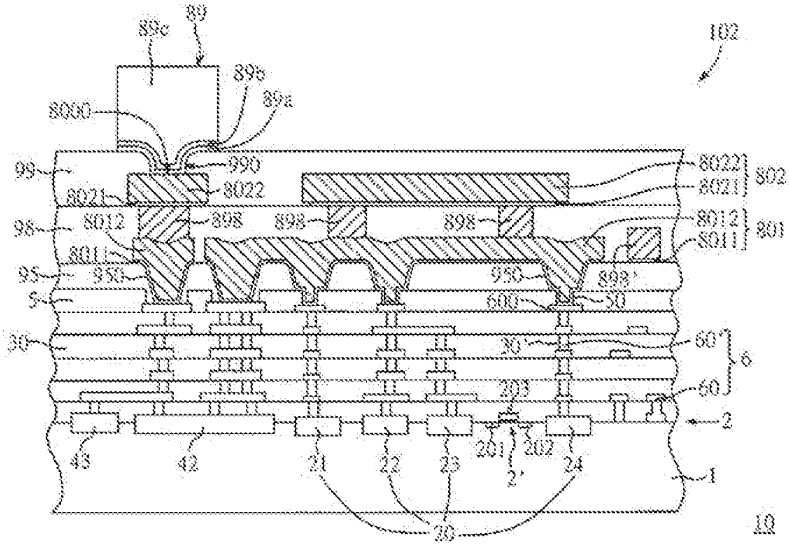


Fig. 16M

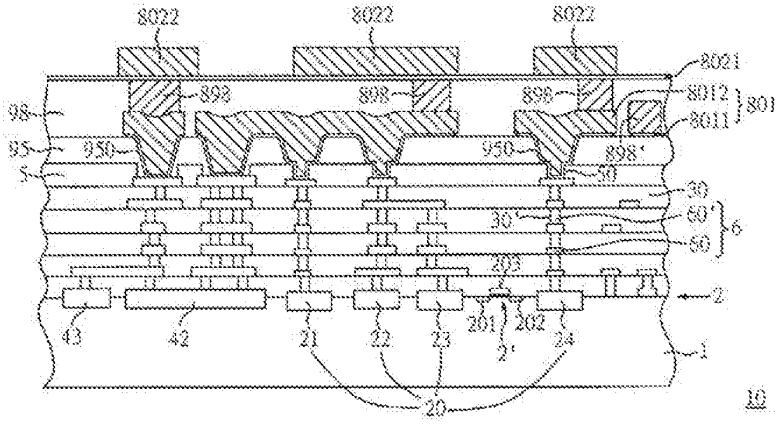


Fig. 17A

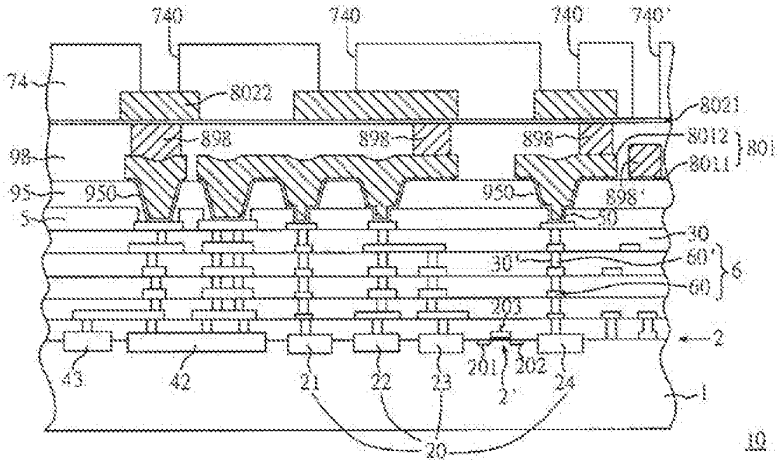


Fig. 17B

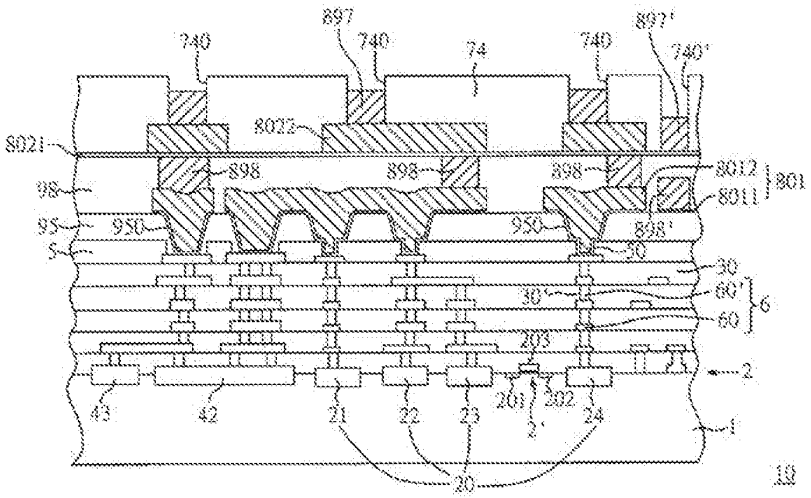


Fig. 17C

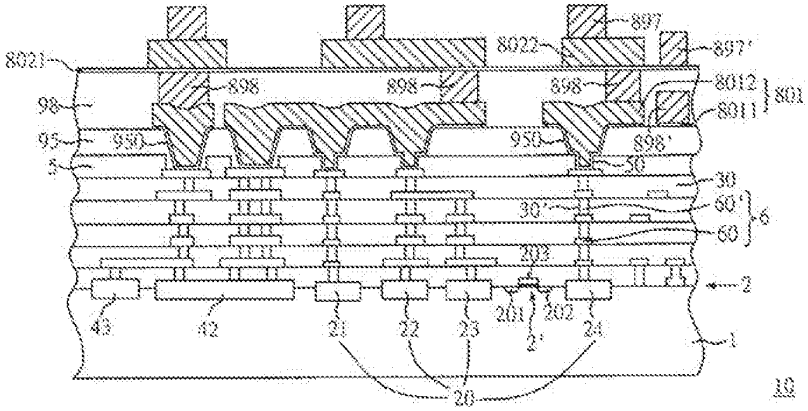


Fig. 17D

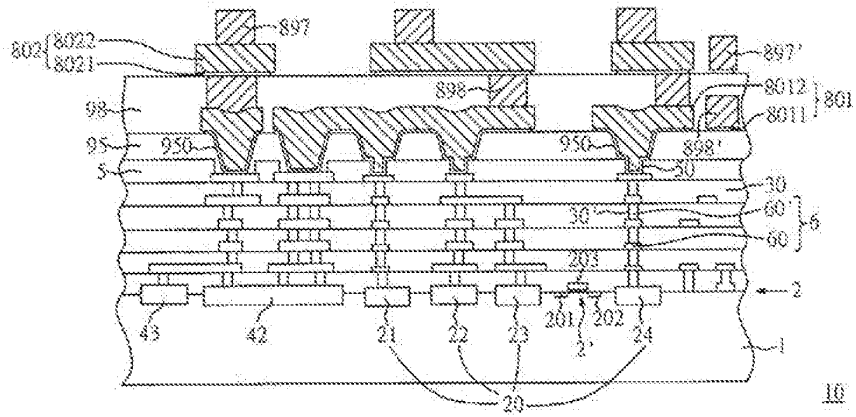


Fig. 17E

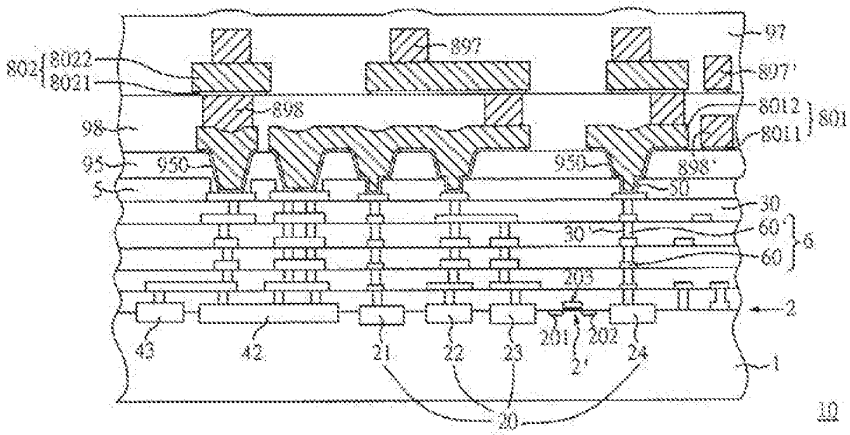


Fig. 17F

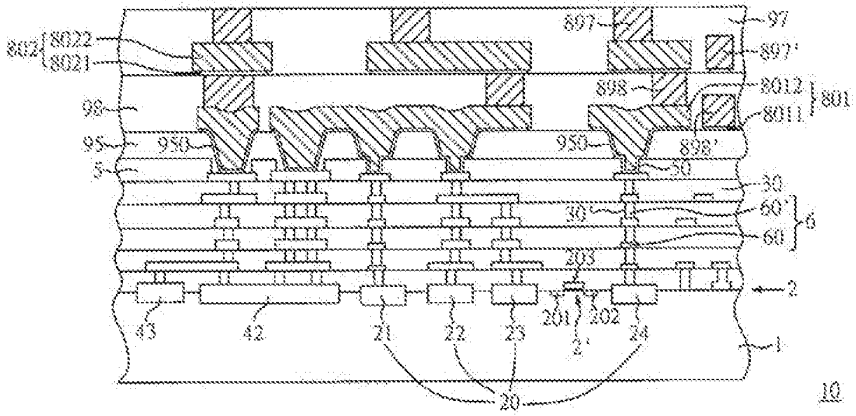


Fig. 17G

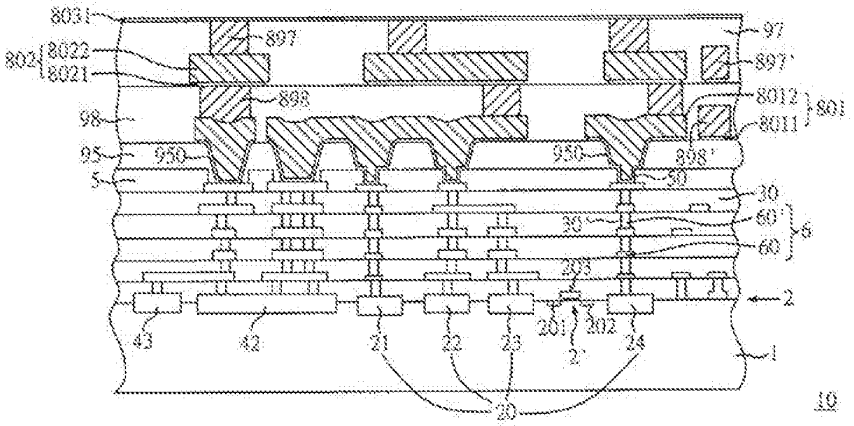


Fig. 17H

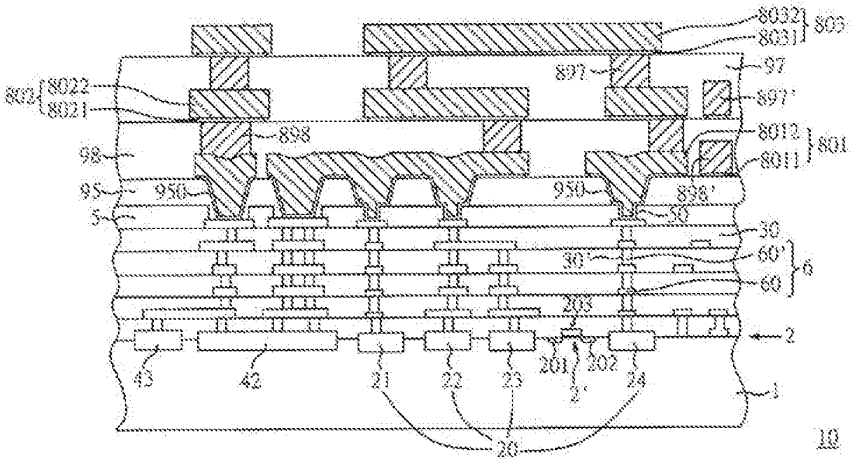


Fig. 17I

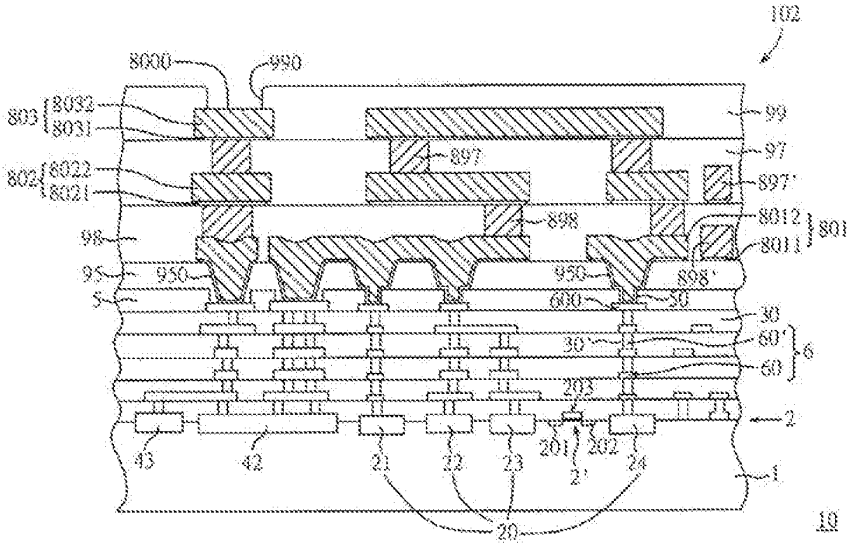


Fig. 17J

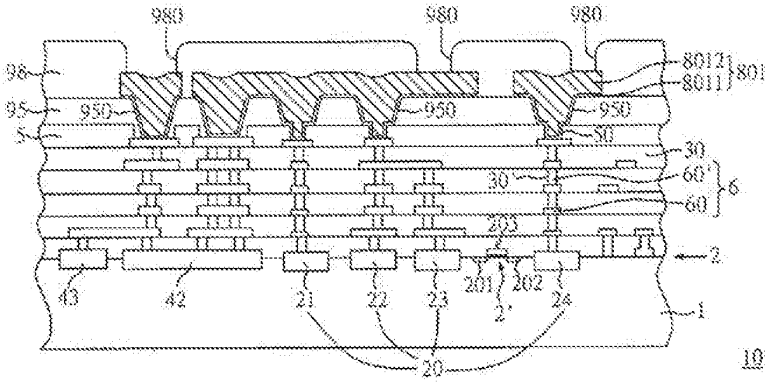


Fig. 18A

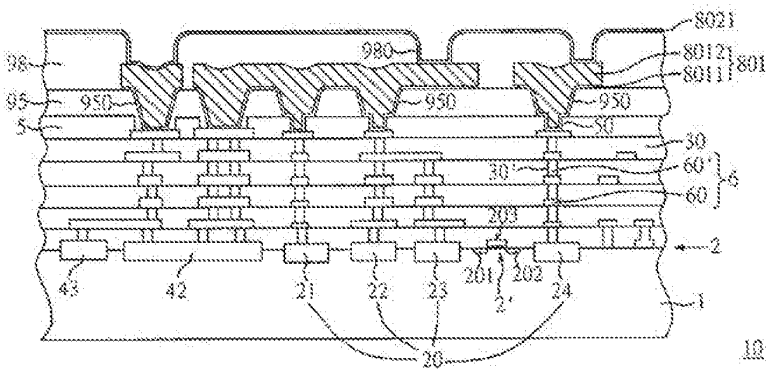


Fig. 18B

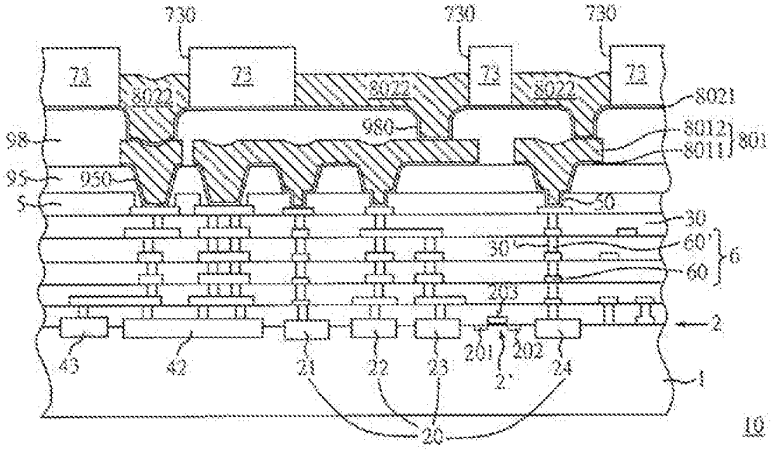


Fig. 18C

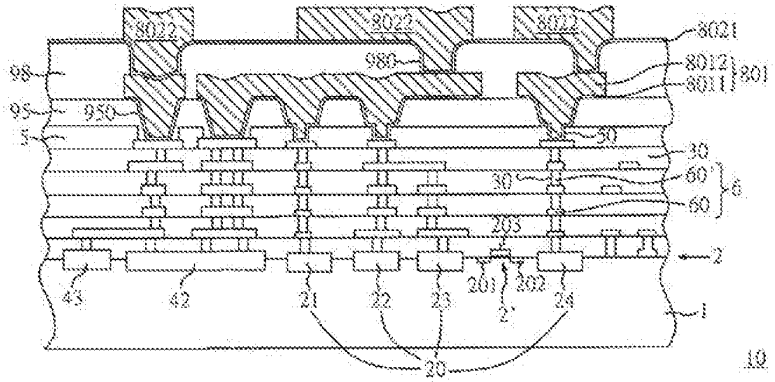


Fig. 18D

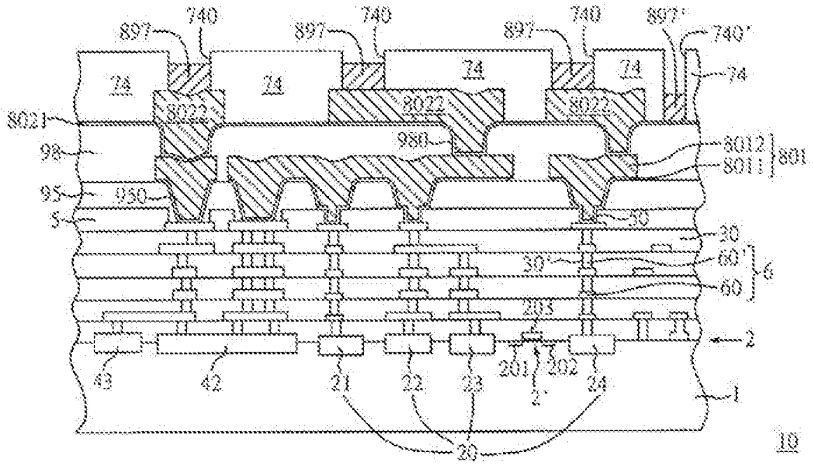


Fig. 18E

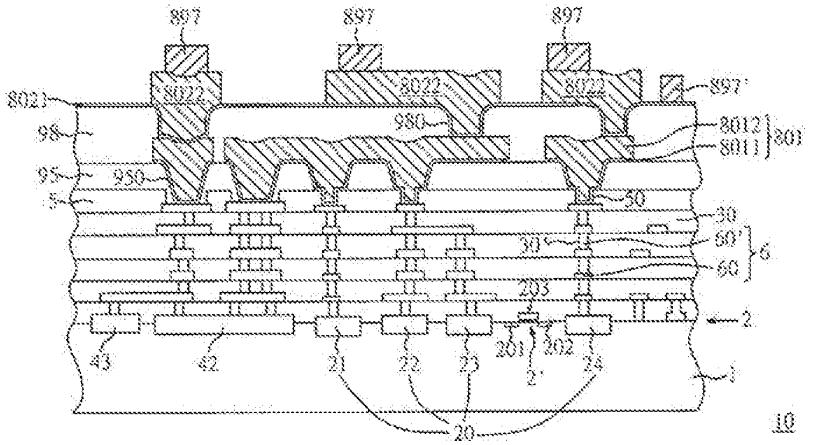


Fig. 18F

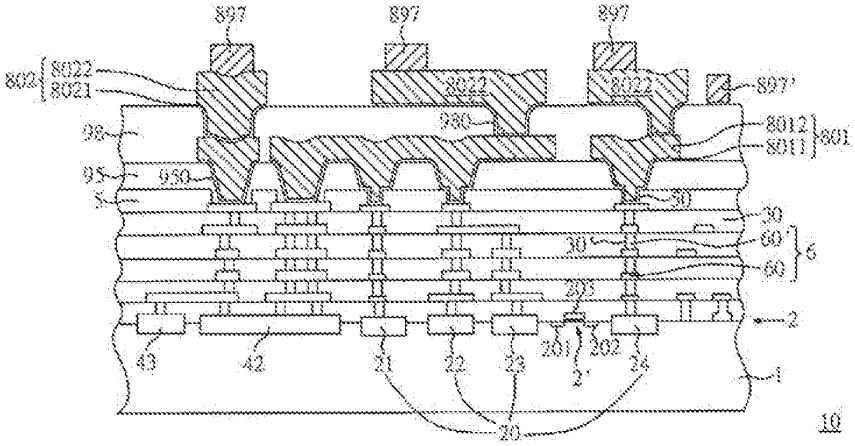


Fig. 18G

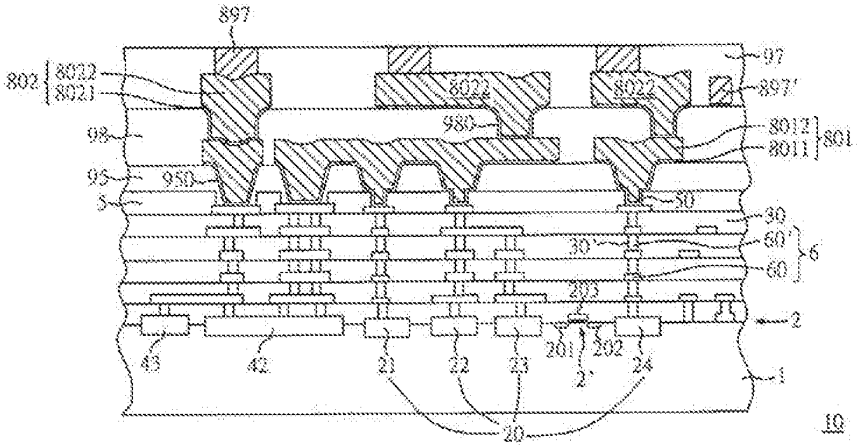


Fig. 18H

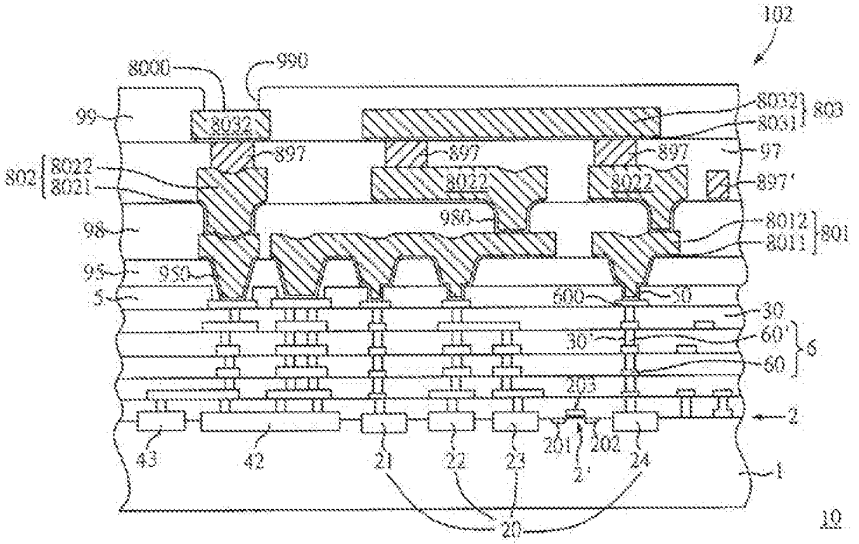


Fig. 18I

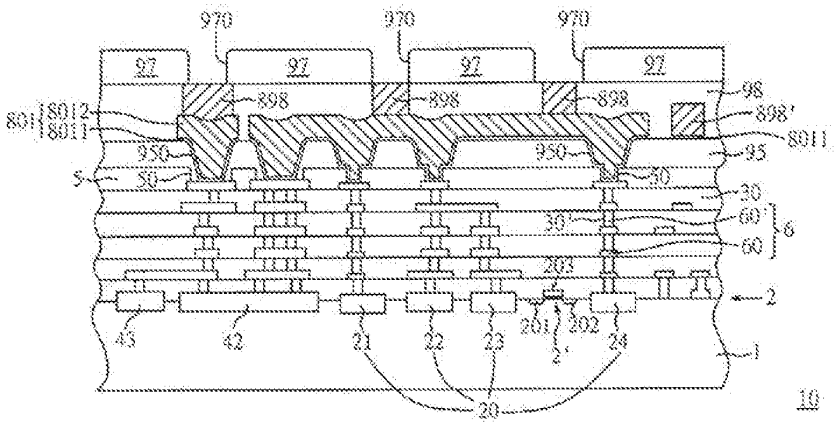


Fig. 19A

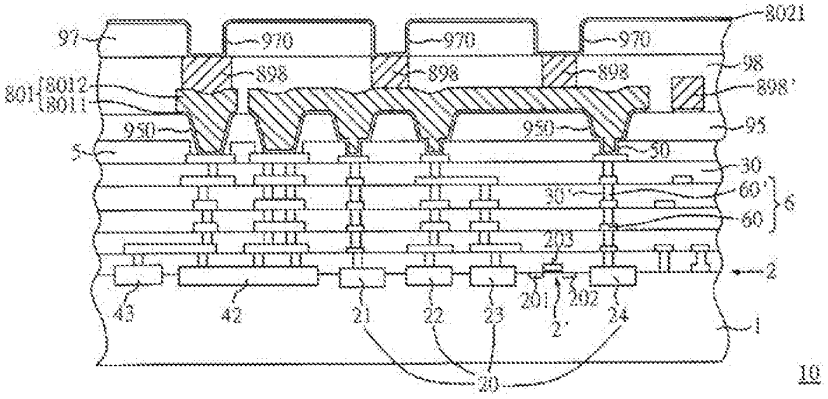


Fig. 19B

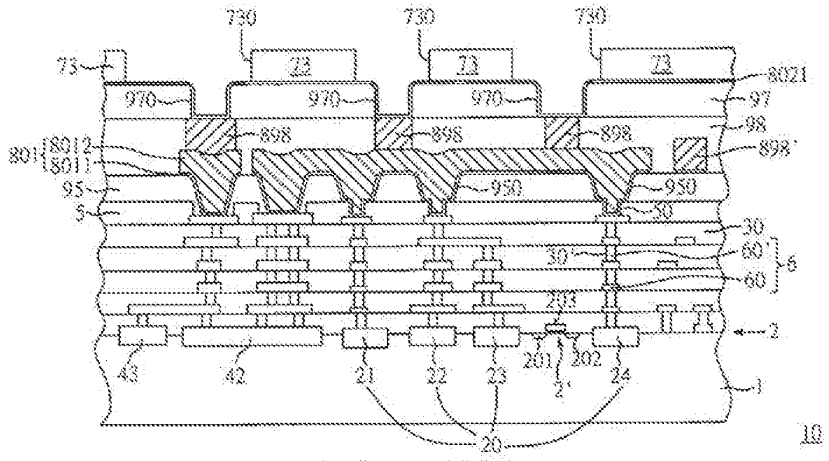


Fig. 19C

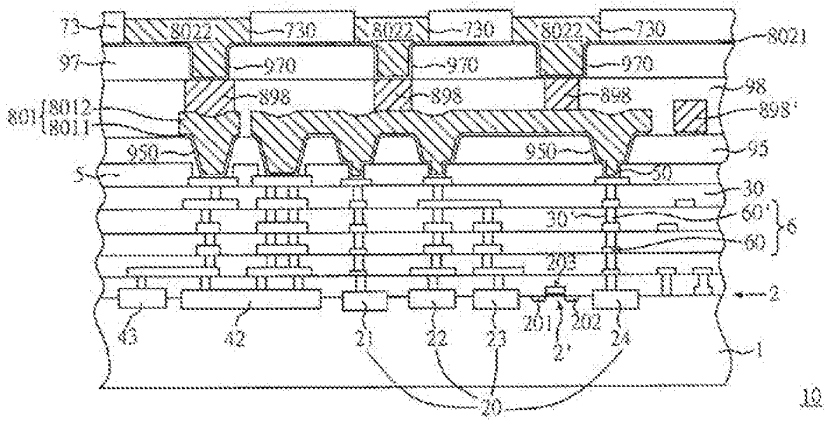


Fig. 19D

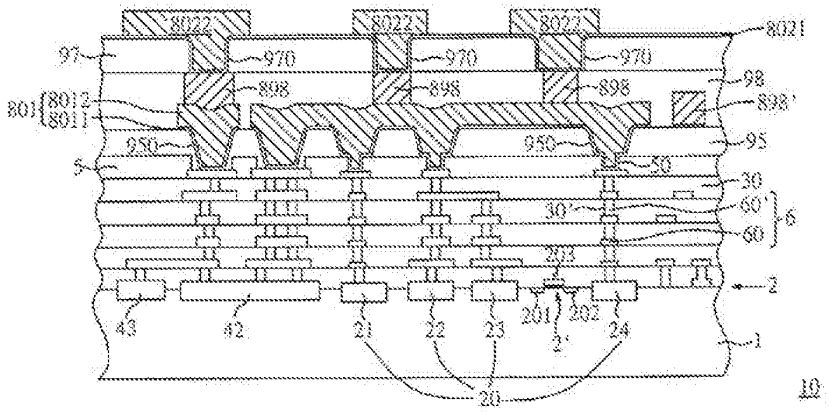


Fig. 19E

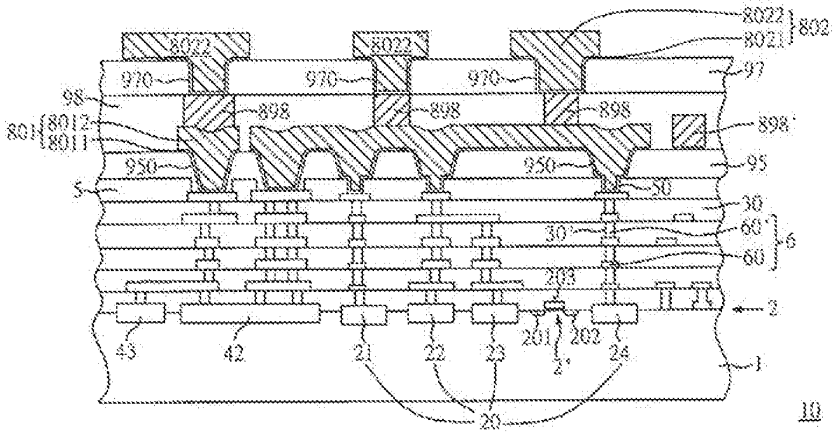


Fig. 19F

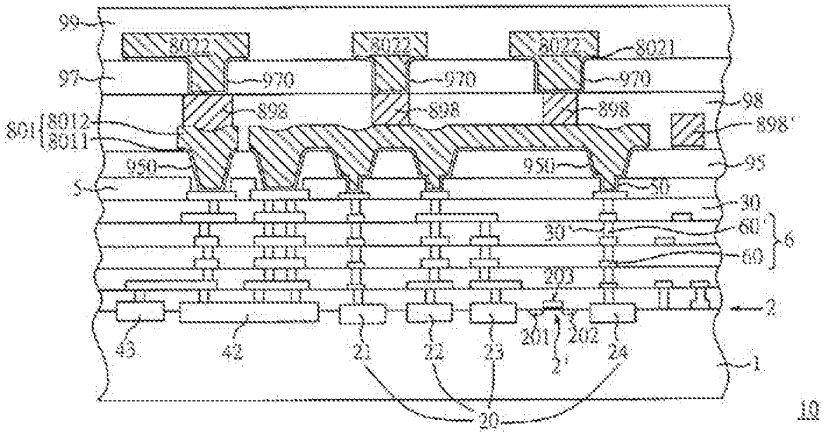


Fig. 19G

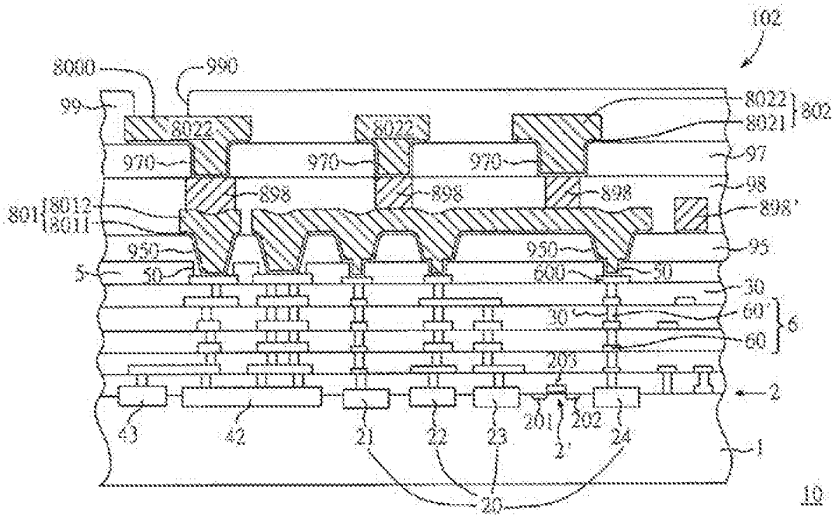


Fig. 19H

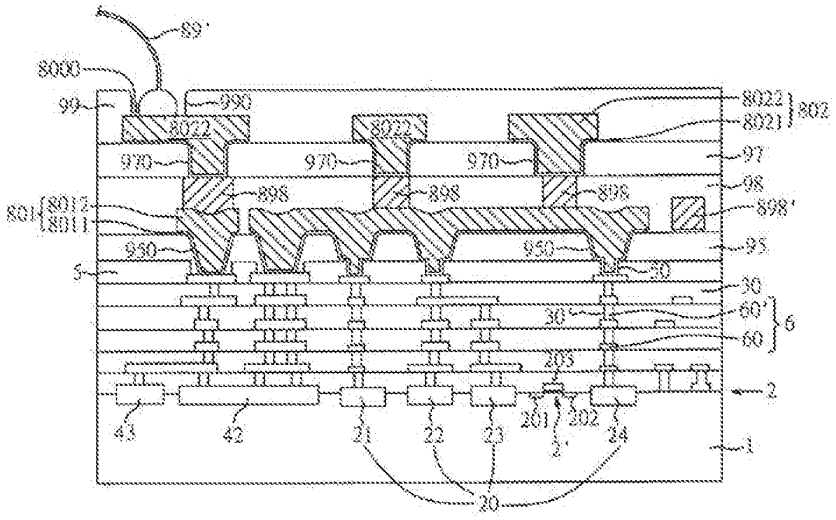


Fig. 19I

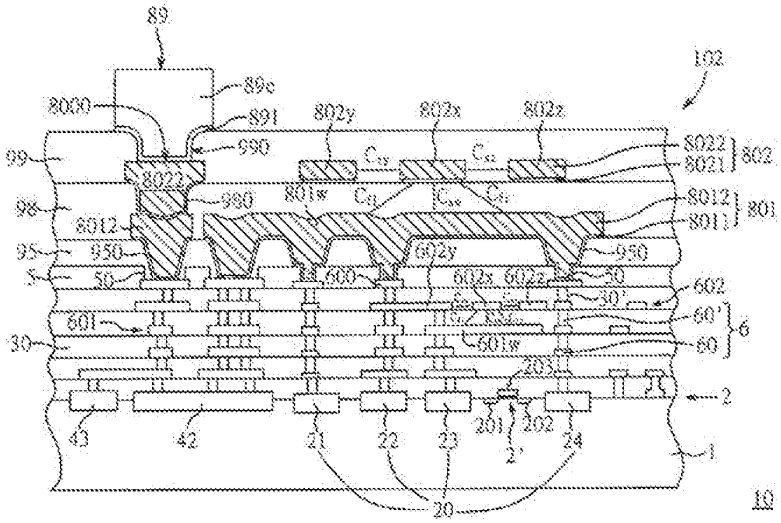


Fig. 20

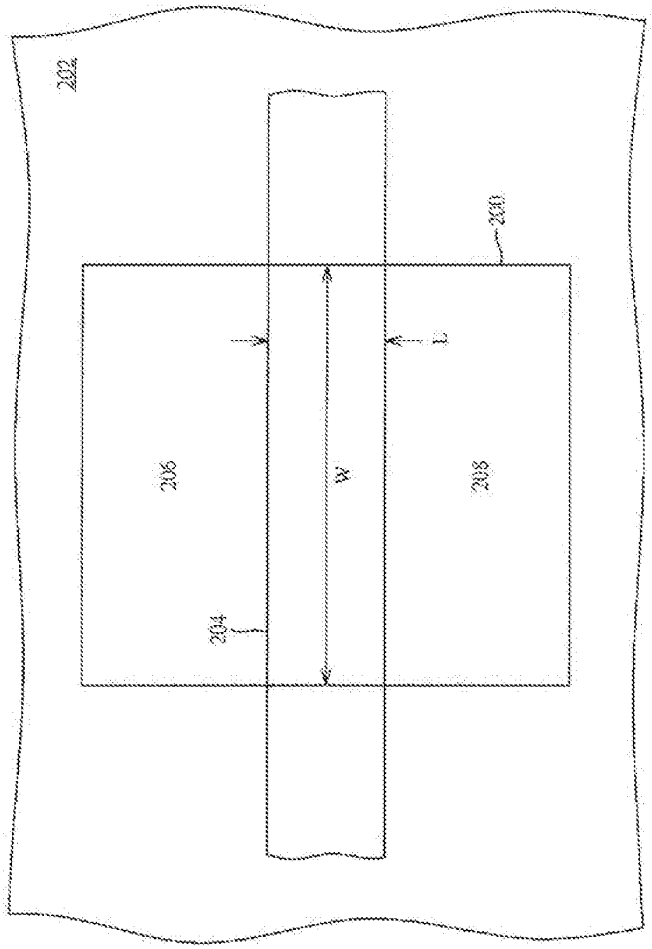


Fig. 21

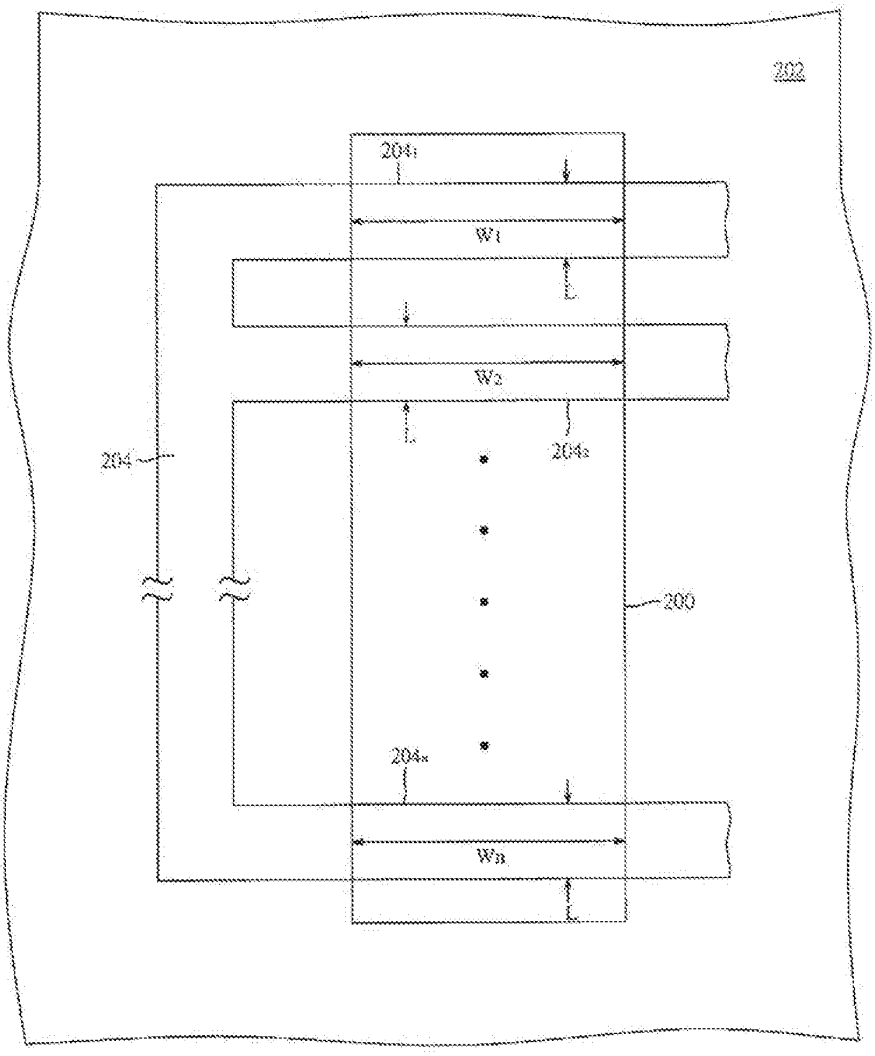


Fig. 22

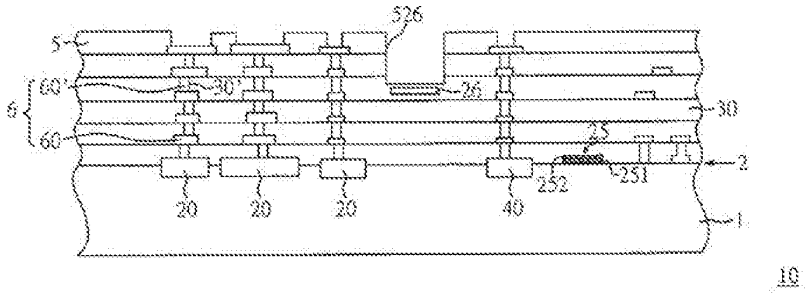


Fig. 23A

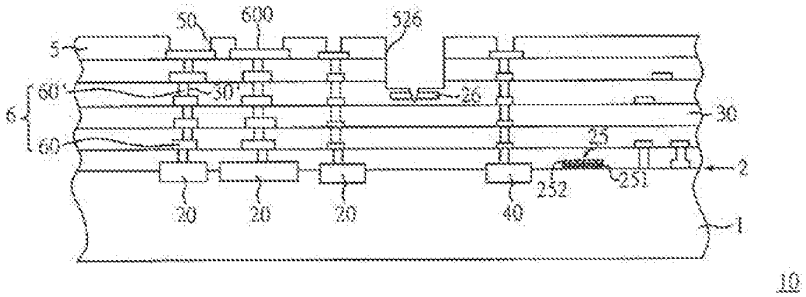


Fig. 23B

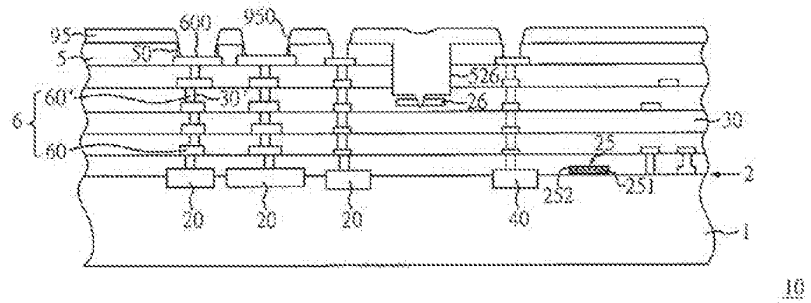


Fig. 23C

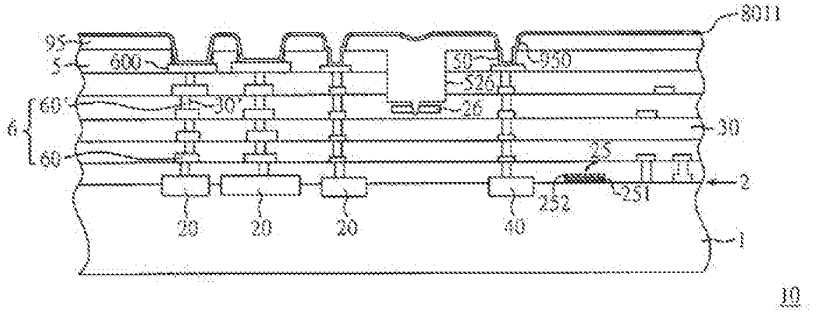


Fig. 23D

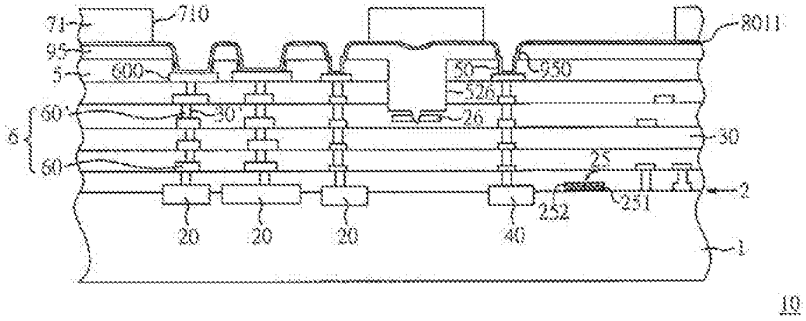


Fig. 23E

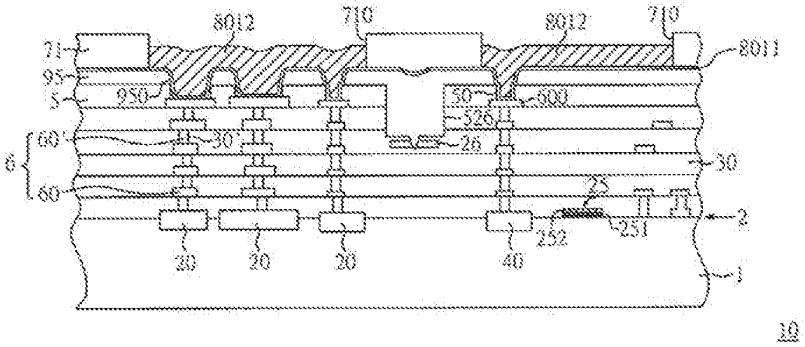


Fig. 23F

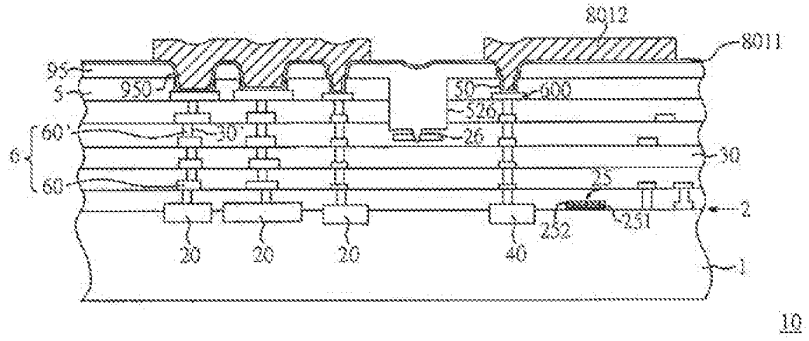


Fig. 23G

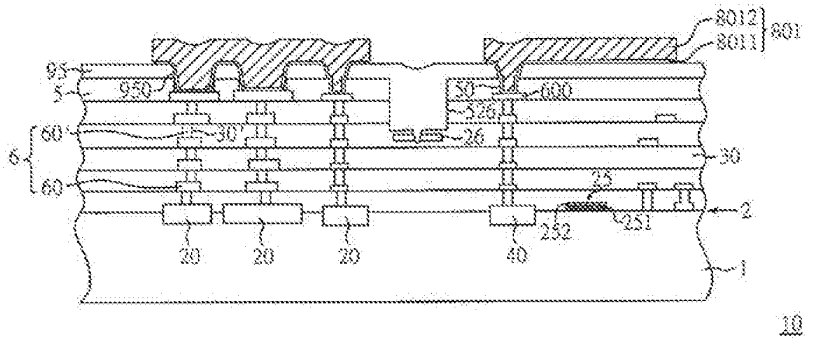


Fig. 23H

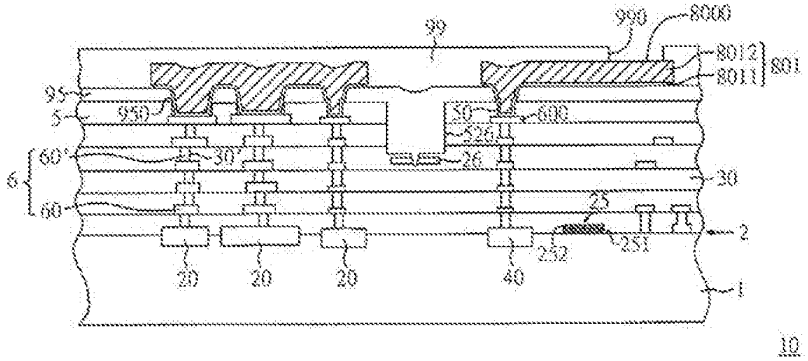


Fig. 23I

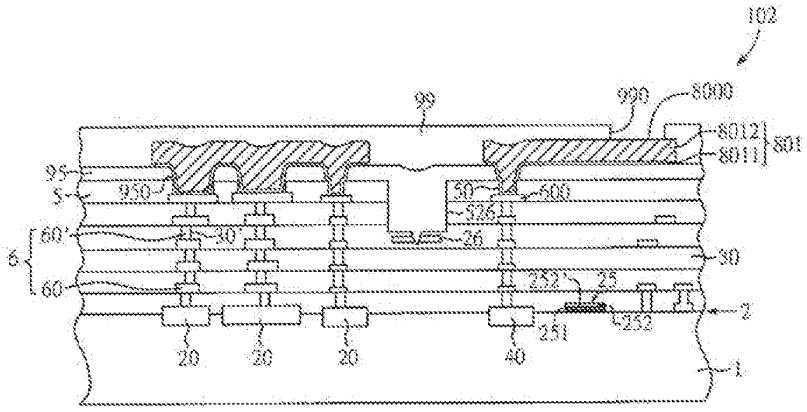


Fig. 23J

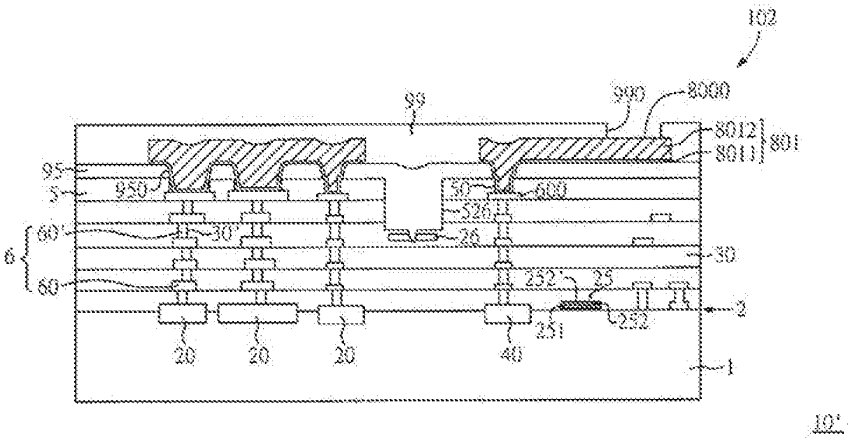


Fig. 23K

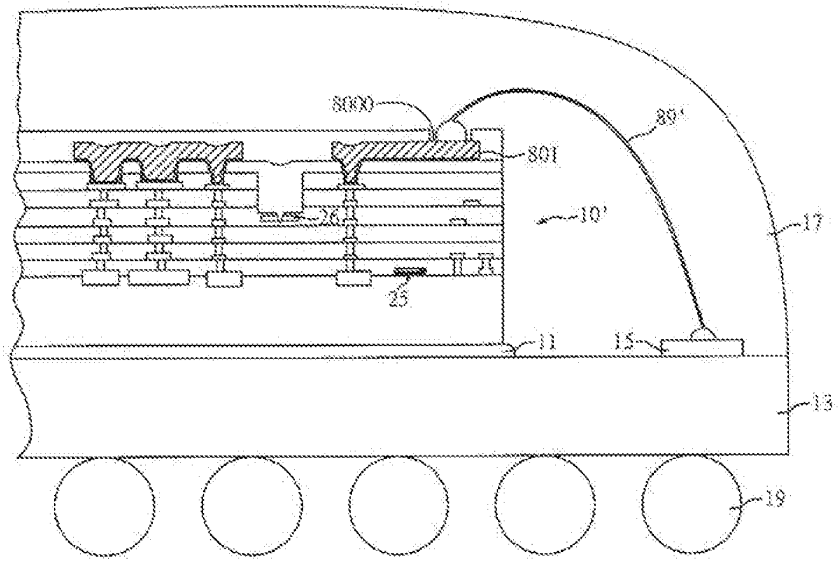


Fig. 23L

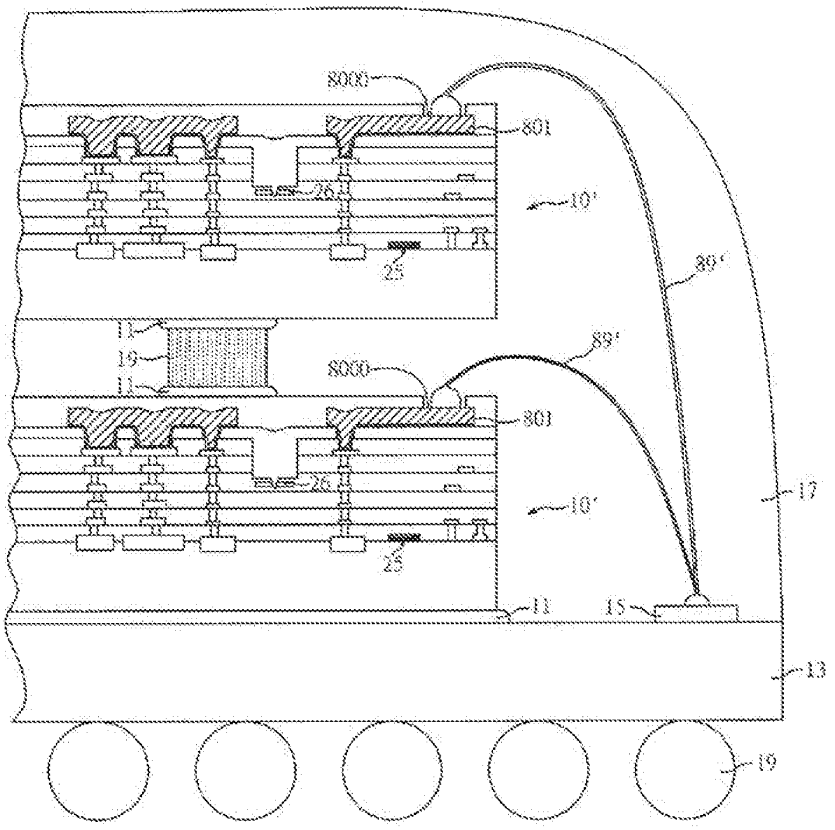


Fig. 23M

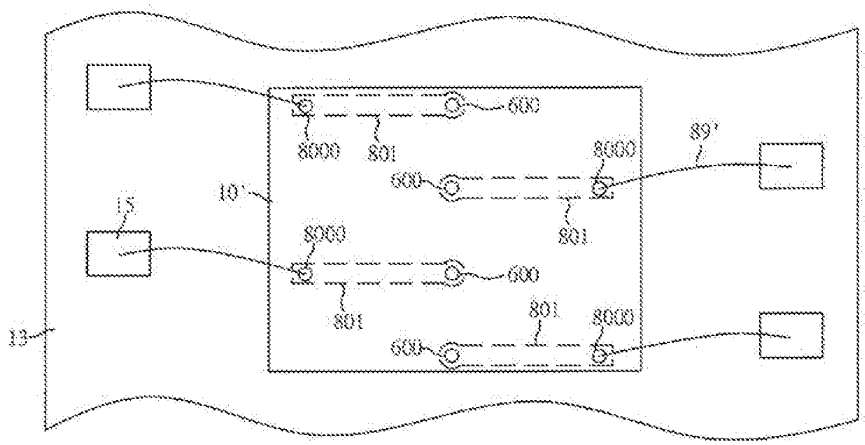


Fig. 23N

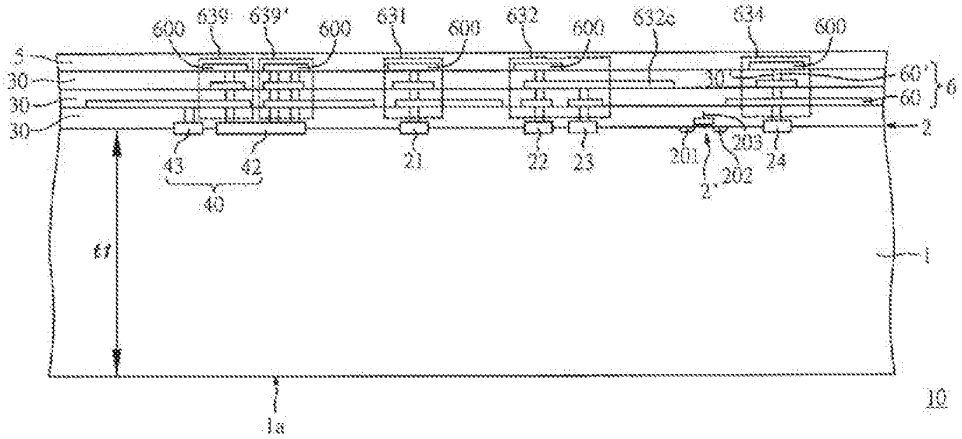


Fig. 24A

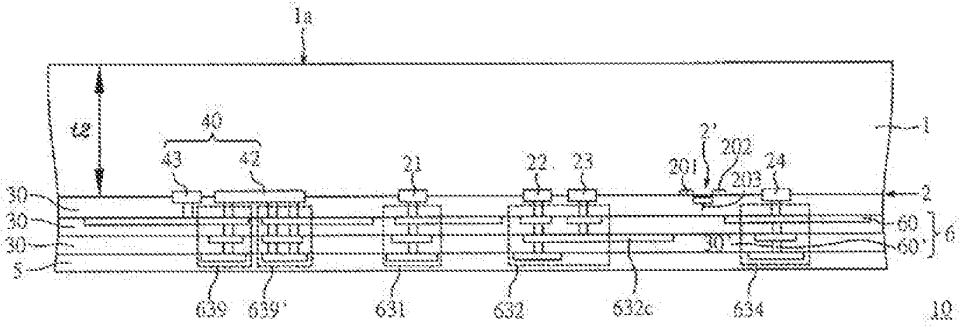


Fig. 24B

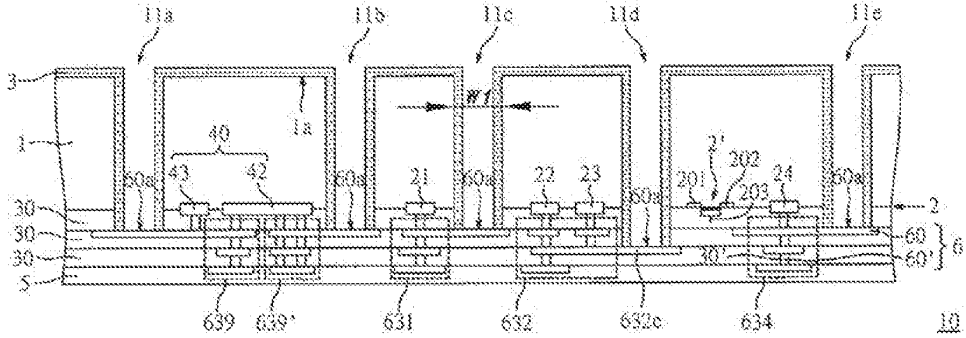


Fig. 24C

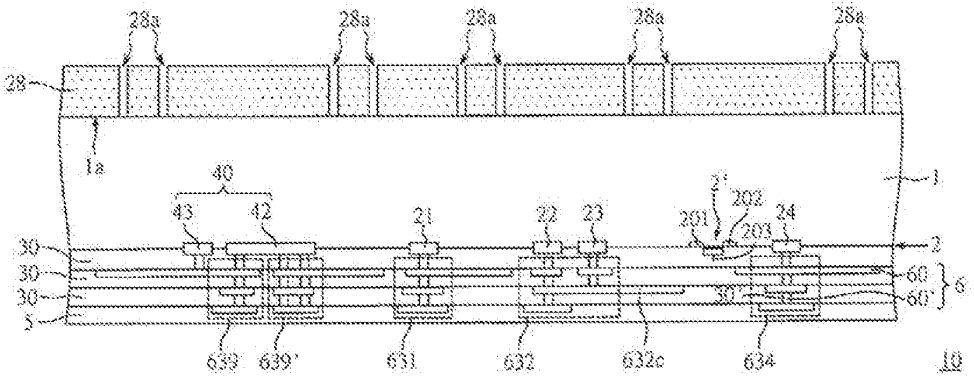


Fig. 24D

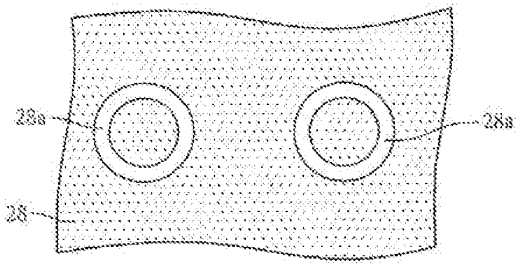


Fig. 24E

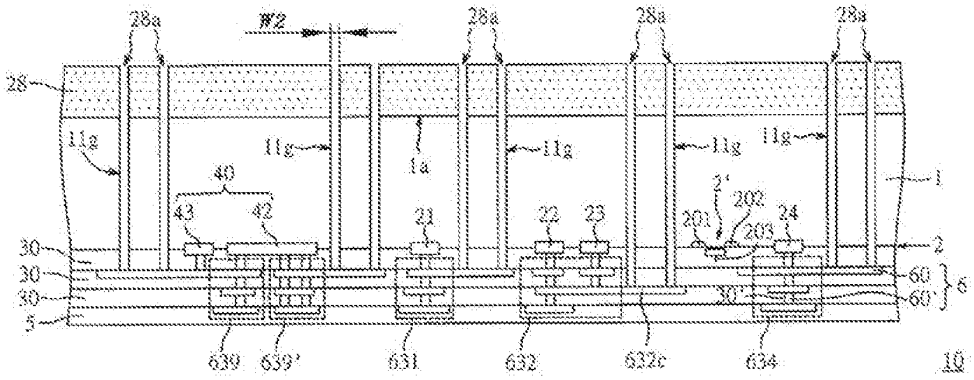


Fig. 24F

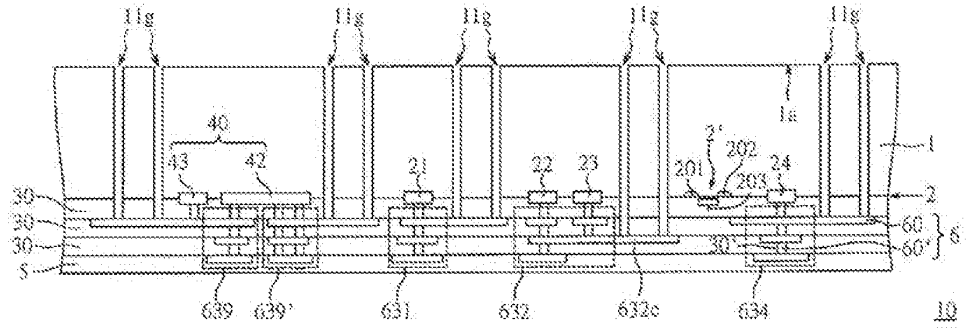


Fig. 24G

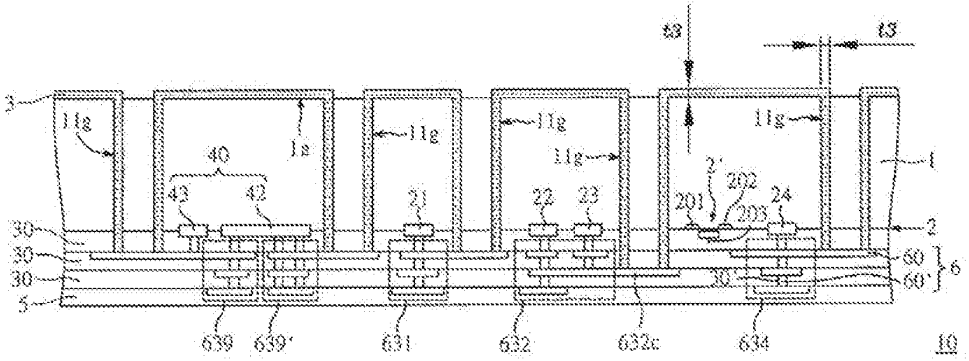


Fig. 24H

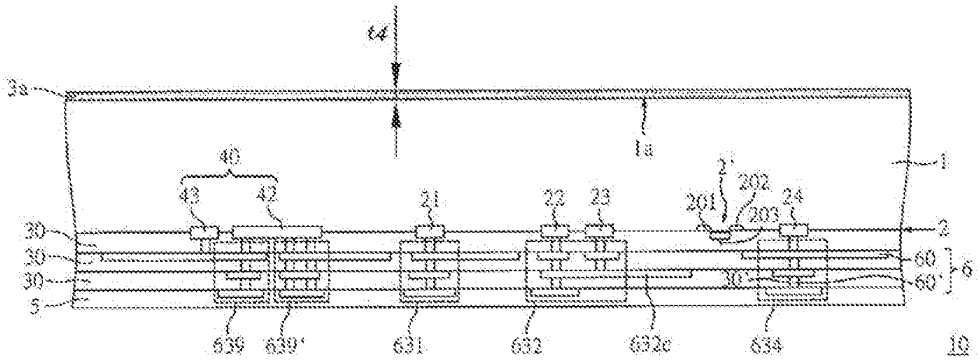


Fig. 24I

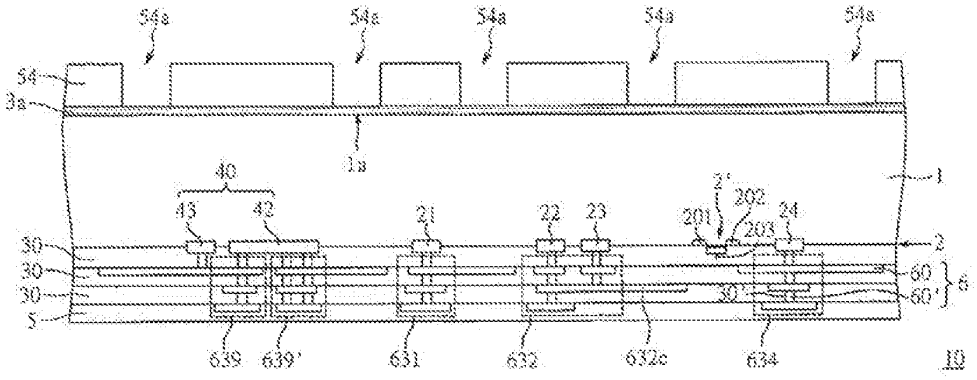


Fig. 24J

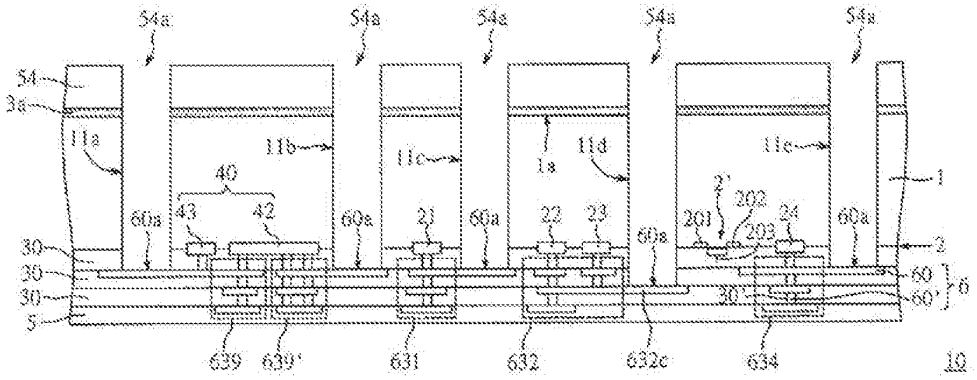


Fig. 24K

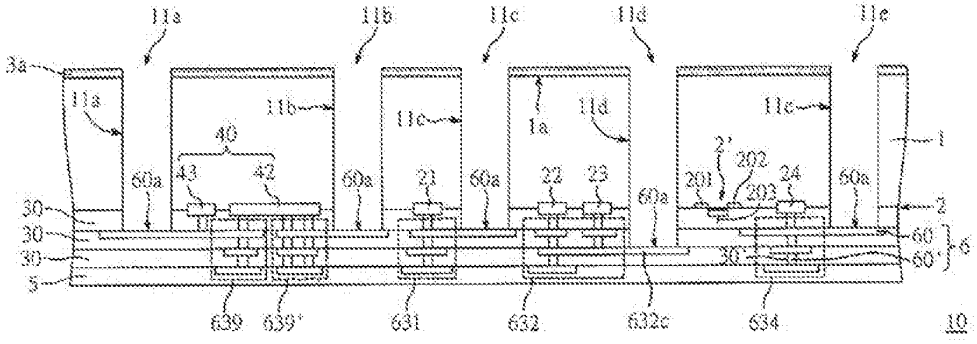


Fig. 24L

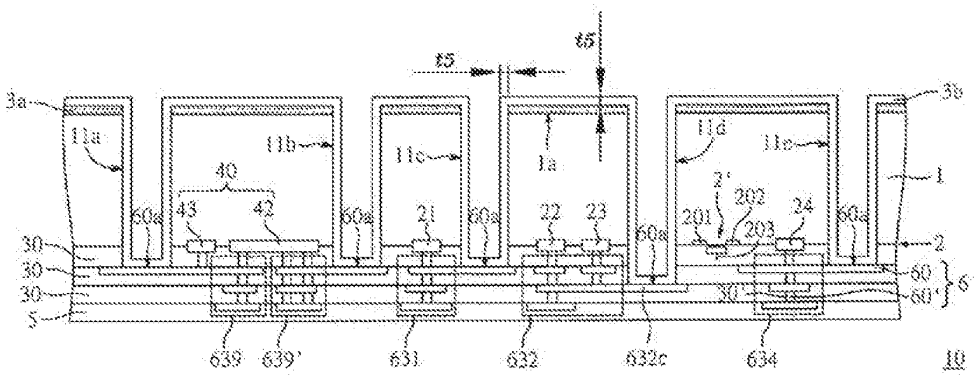


Fig. 24M

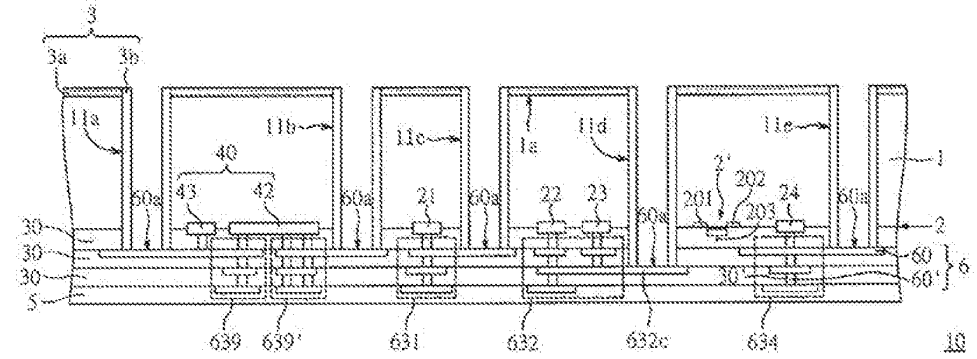


Fig. 24N

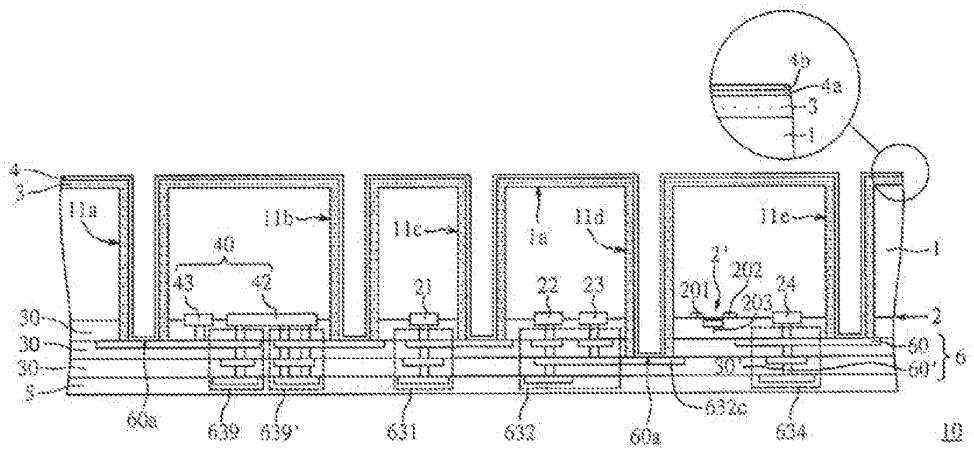


Fig. 25A

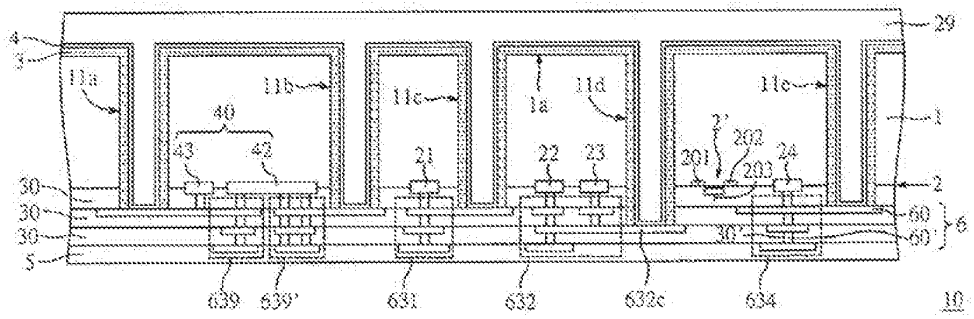


Fig. 25B

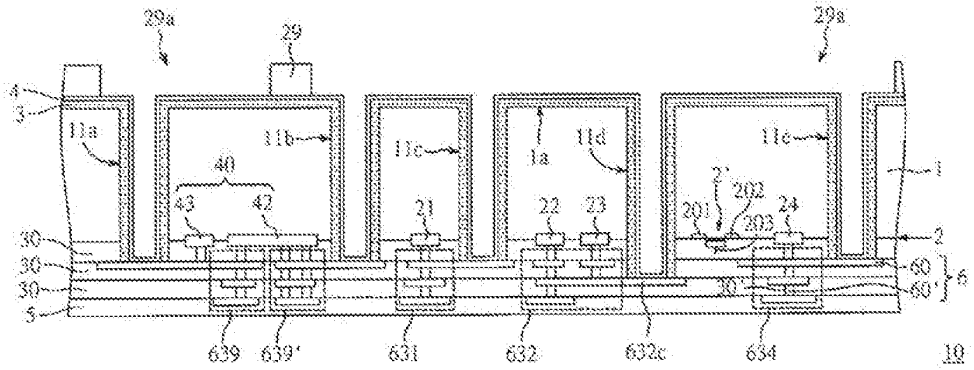


Fig. 25C

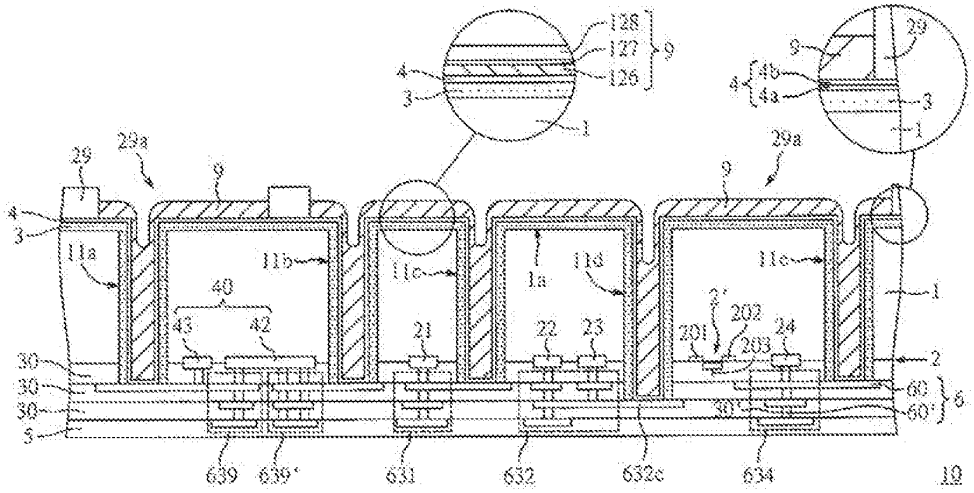


Fig. 25D

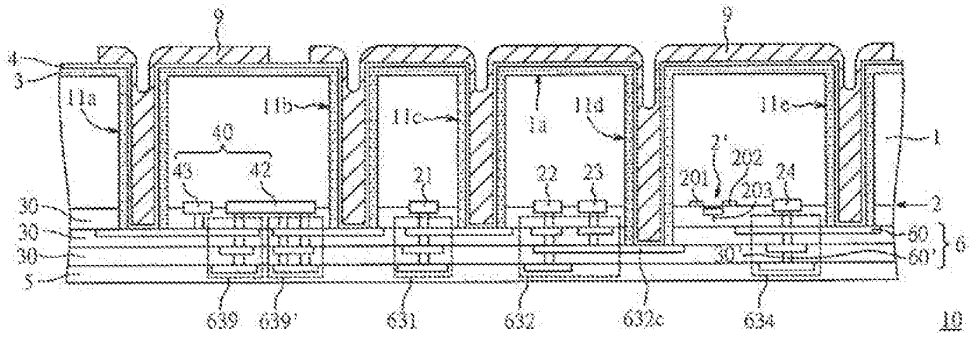


Fig. 25E

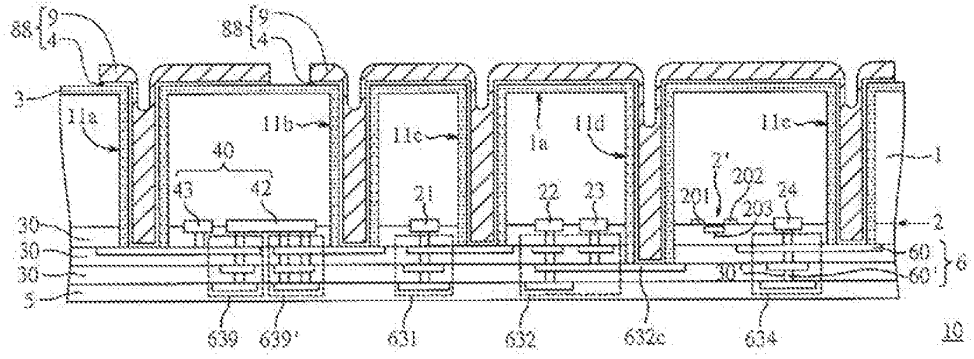


Fig. 25F

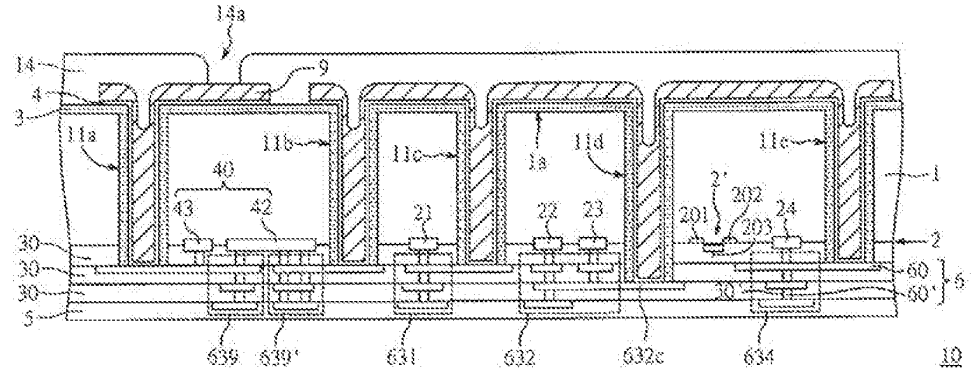


Fig. 25G

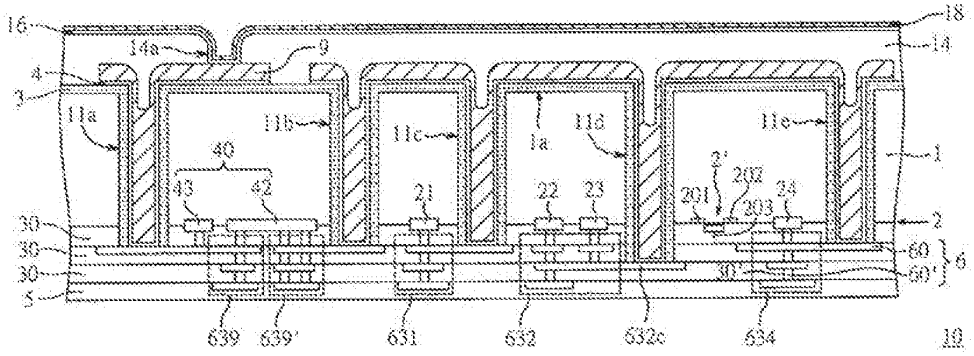


Fig. 25H

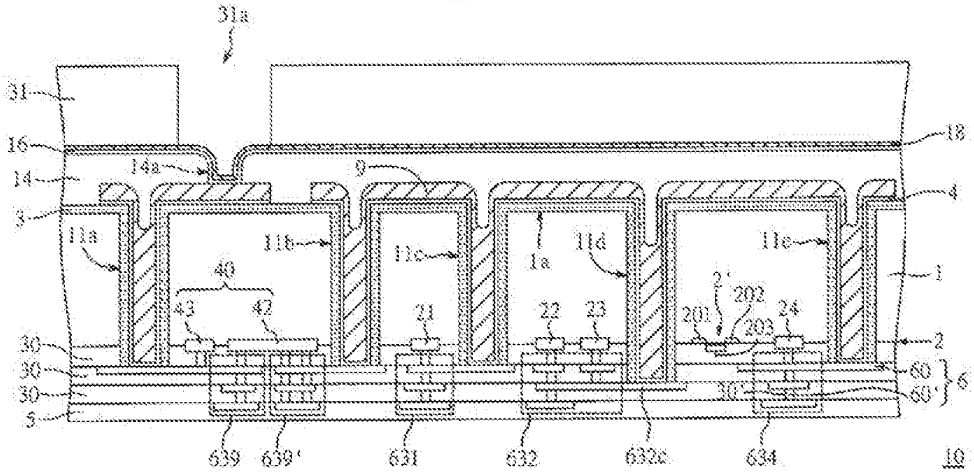


Fig. 25I

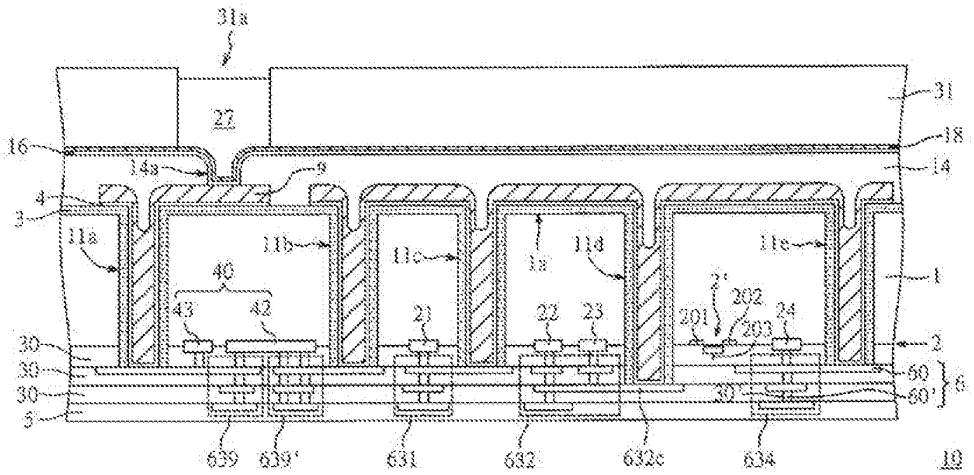


Fig. 25J

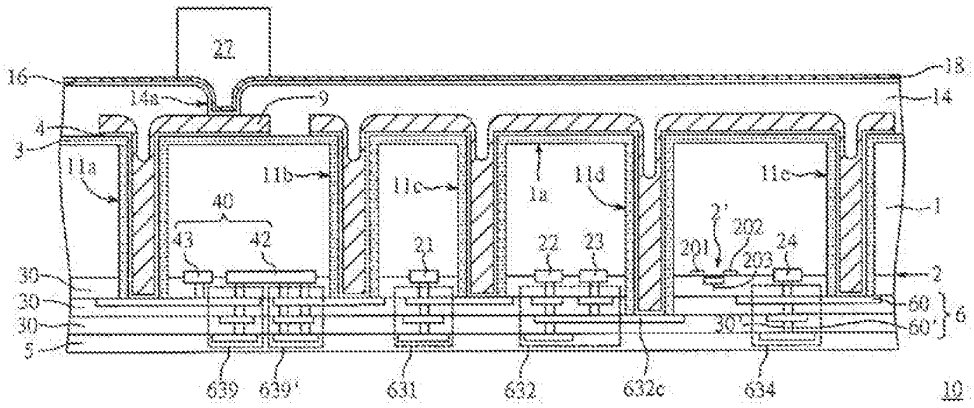


Fig. 25K

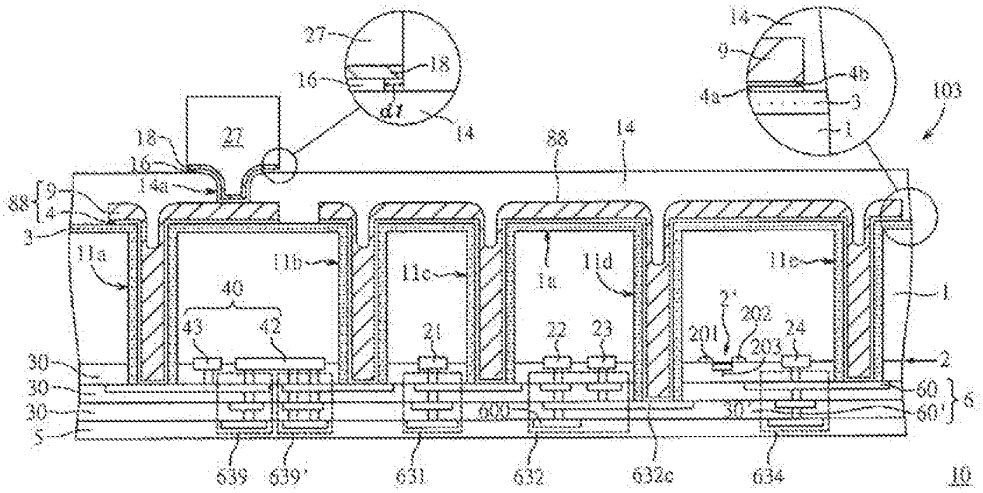


Fig. 25L

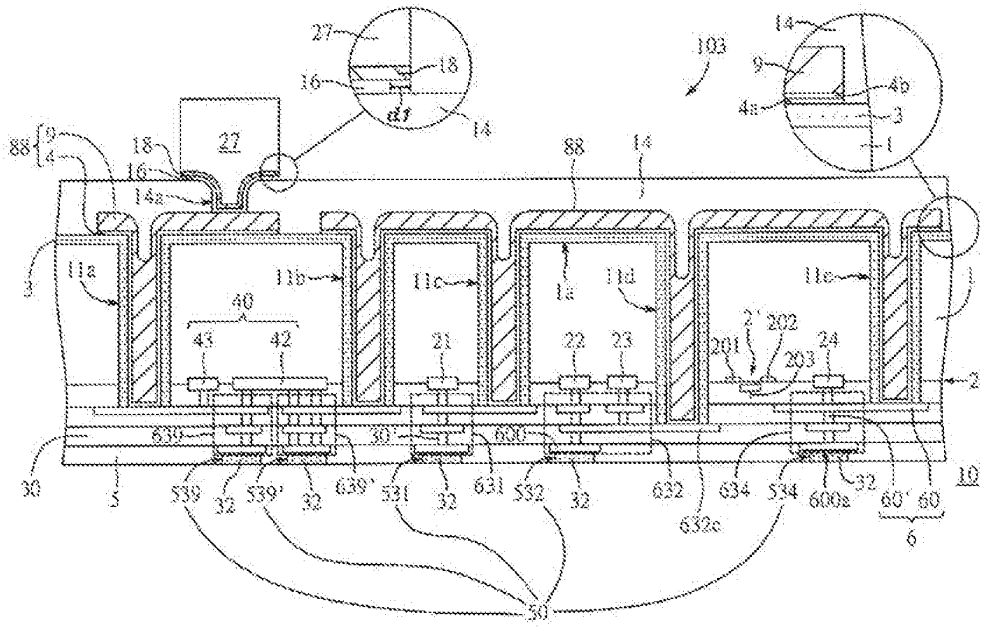


Fig. 25M

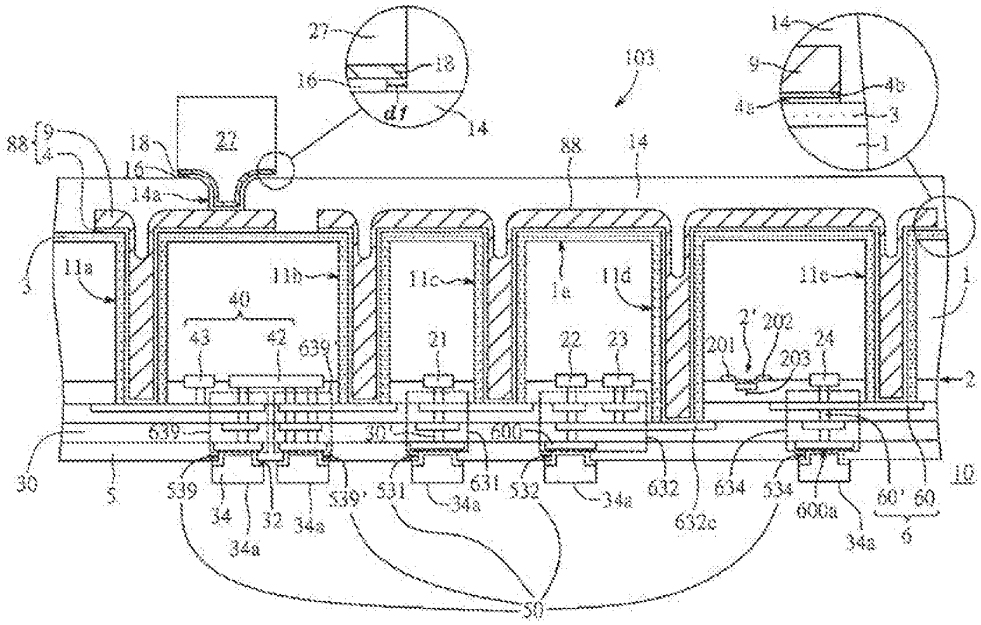


Fig. 25N

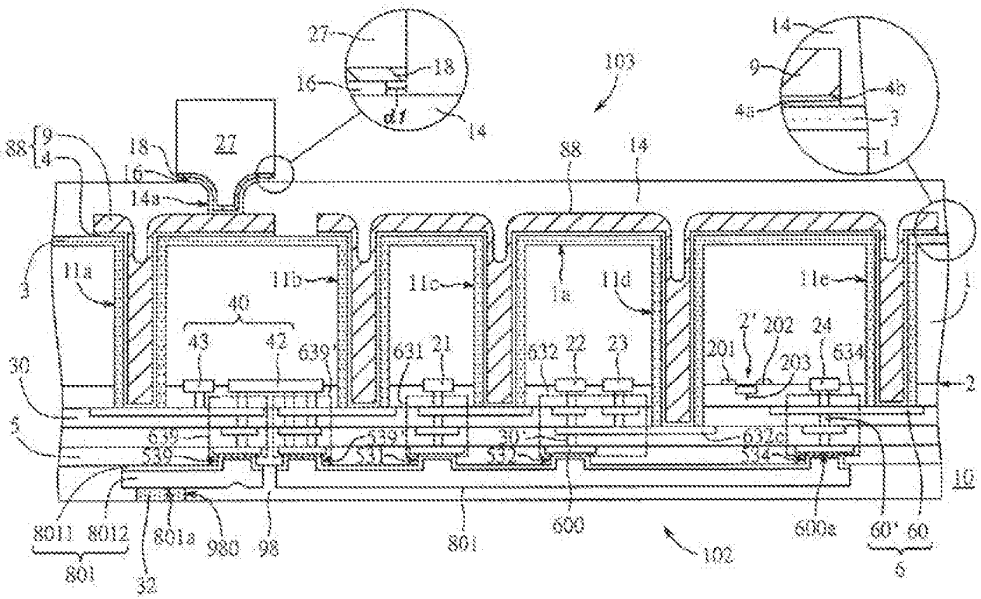


Fig. 25O

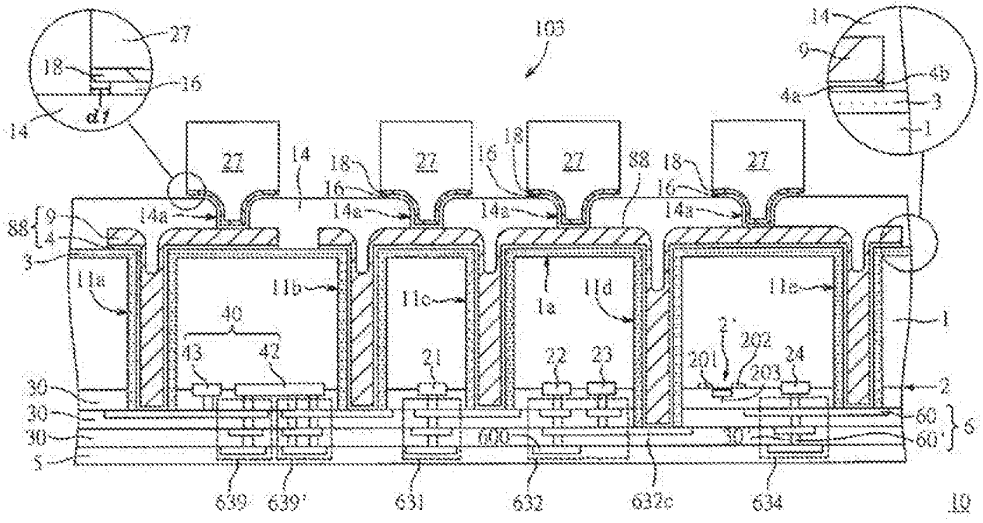


Fig. 25P

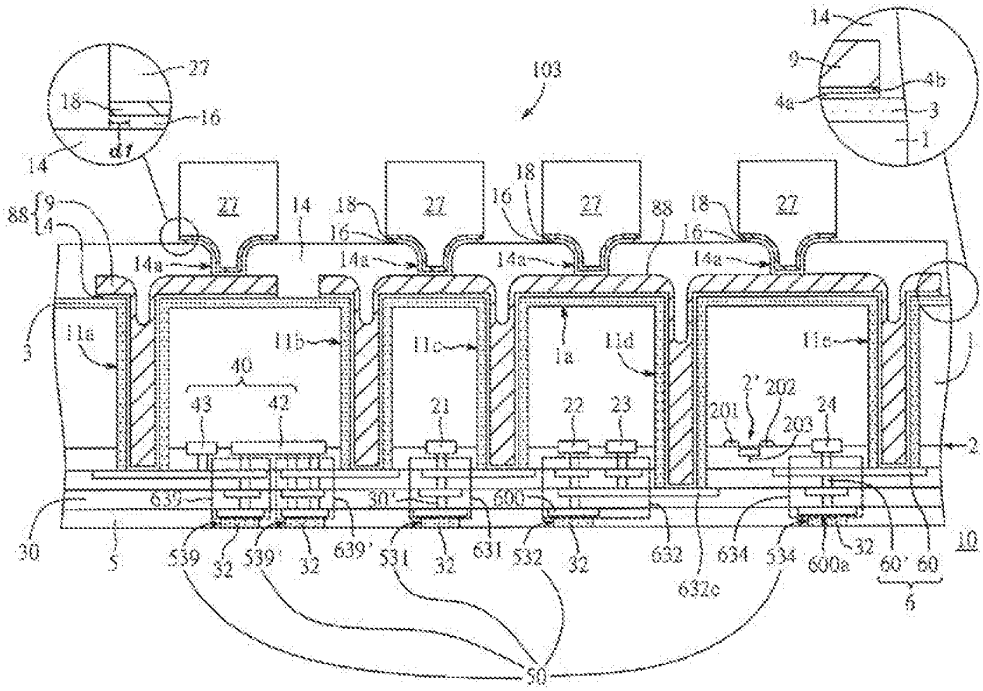


Fig. 25Q

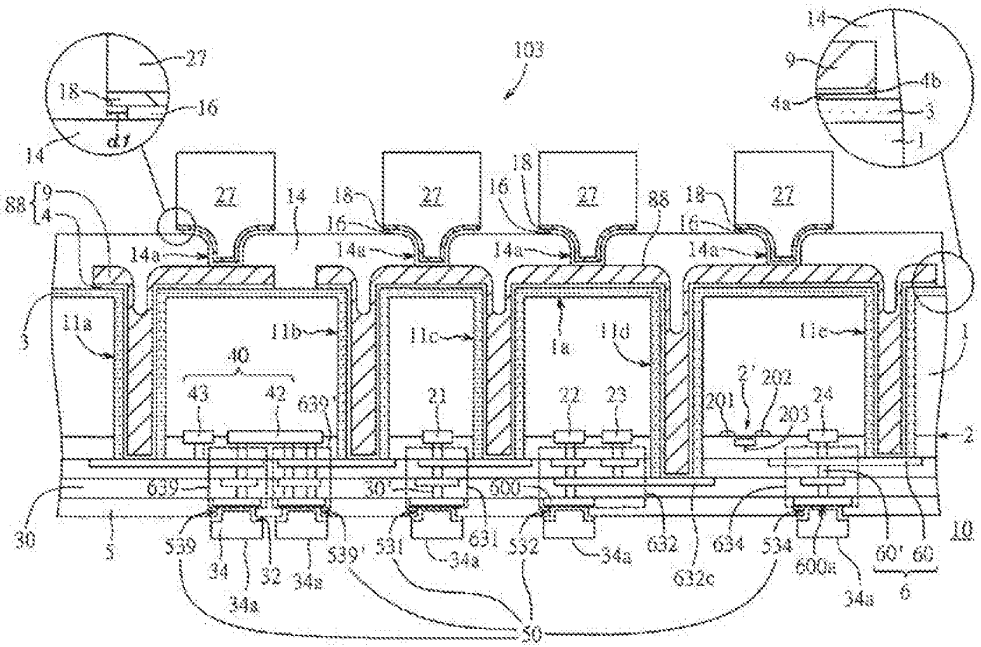


Fig. 25R

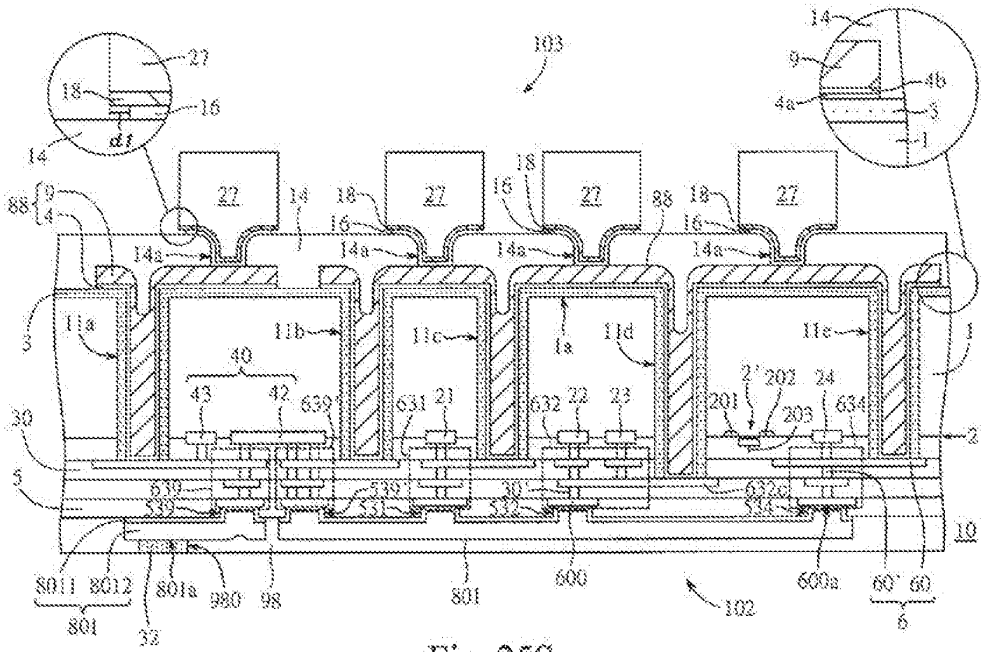


Fig. 25S

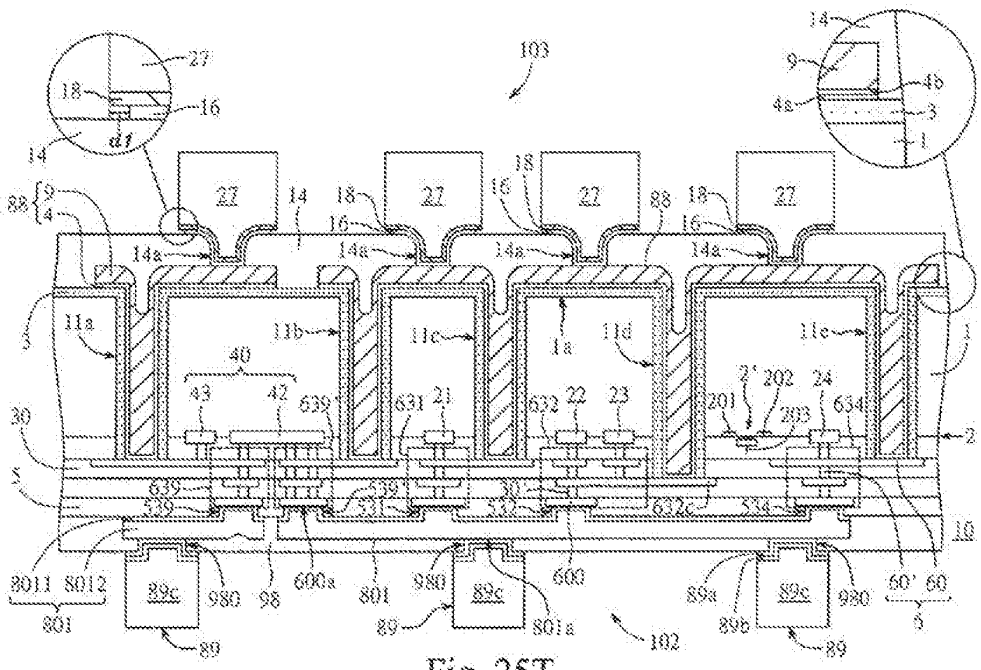


Fig. 25T

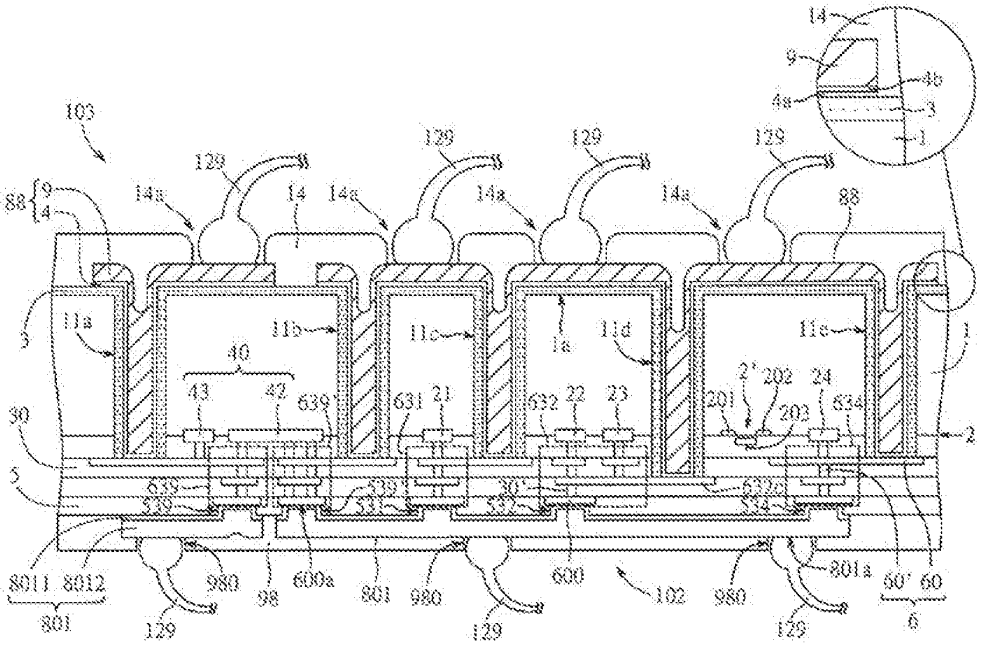


Fig. 25U

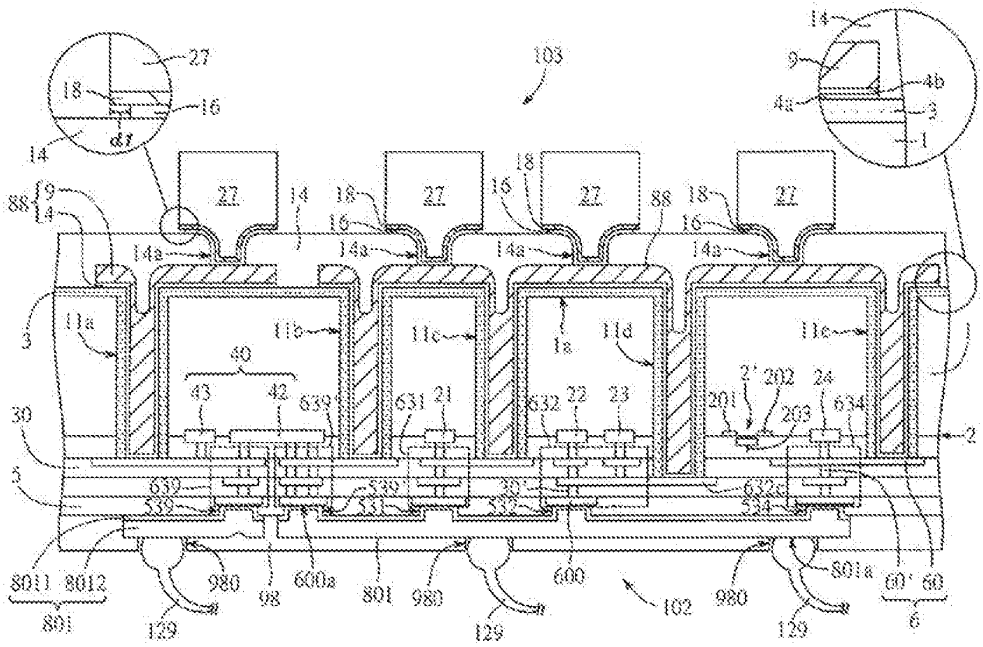


Fig. 25V

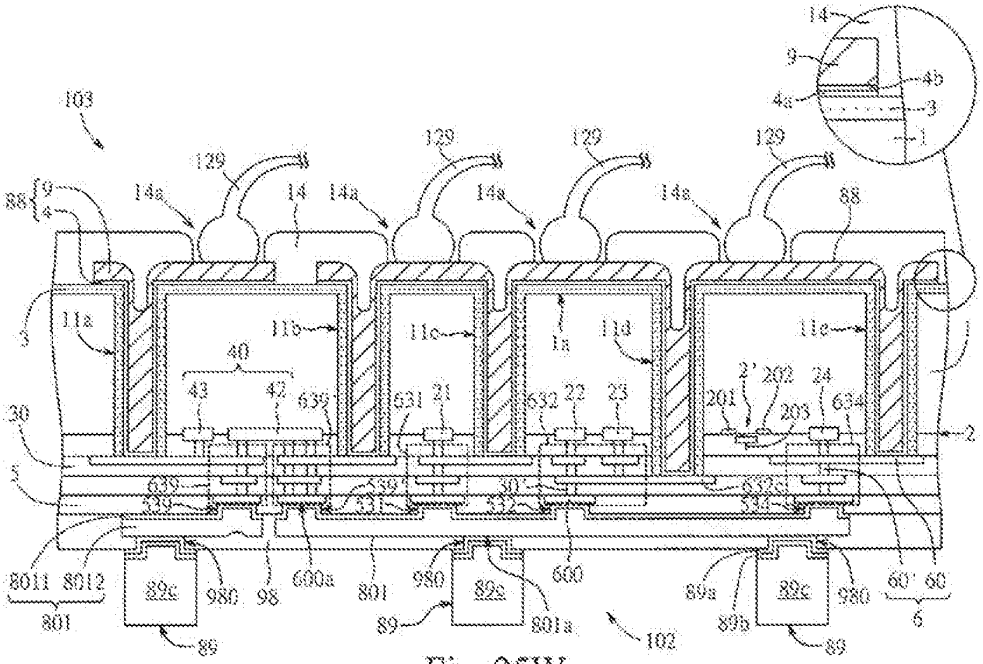


Fig. 25W

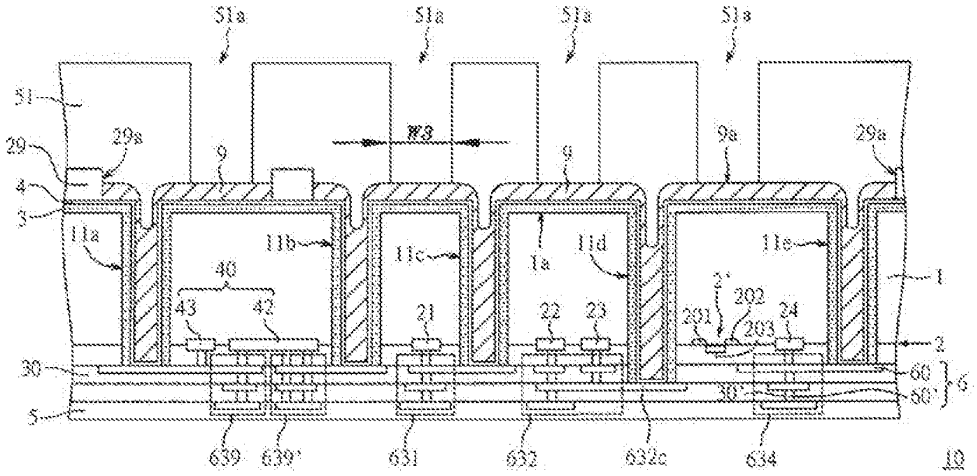


Fig. 26A

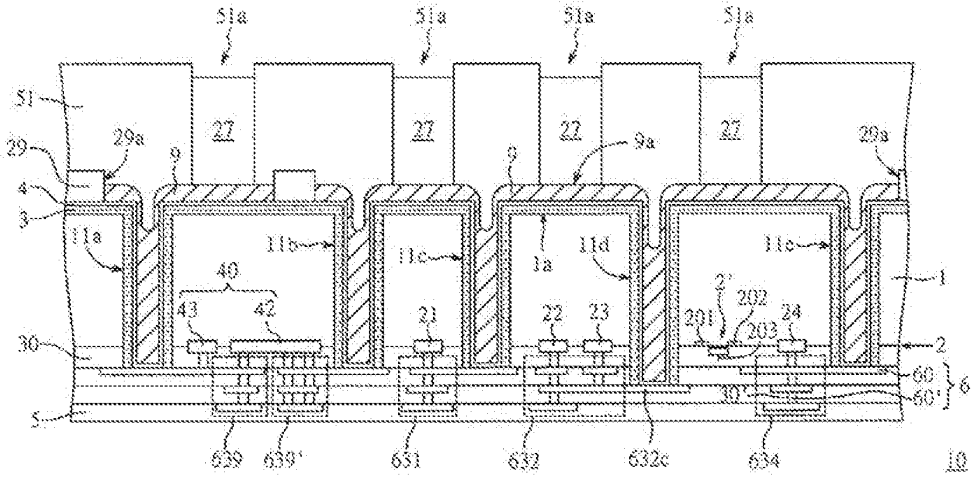


Fig. 26B

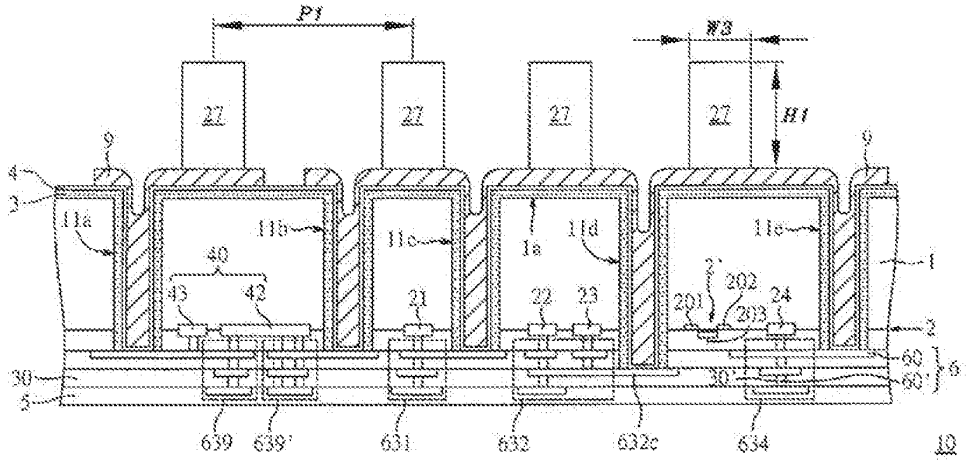


Fig. 26C

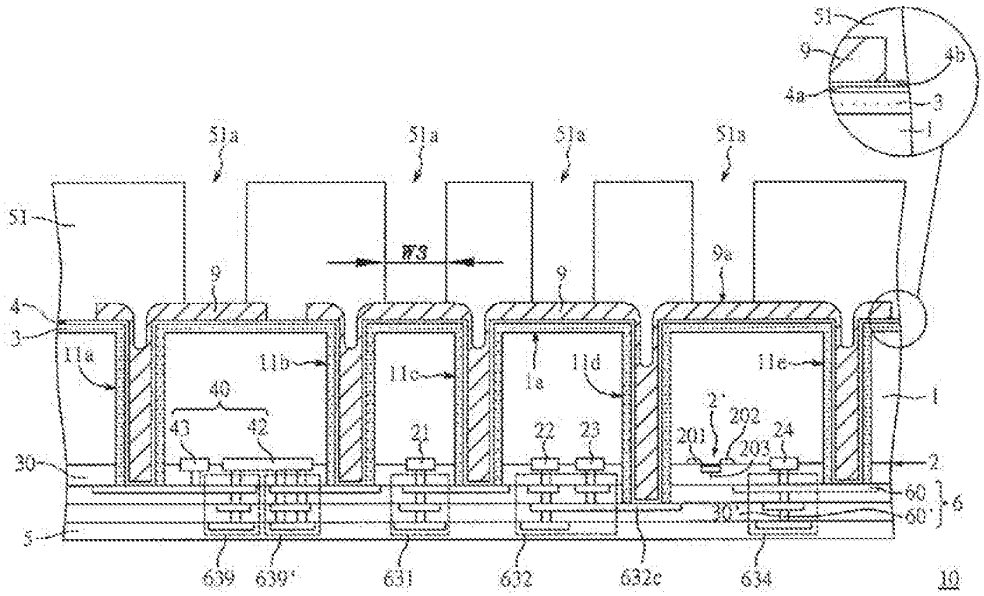


Fig. 26D

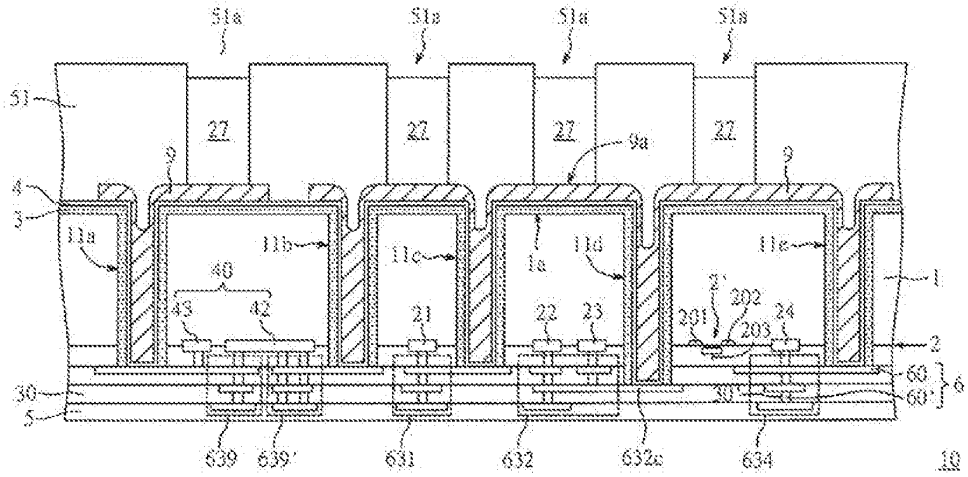


Fig. 26E

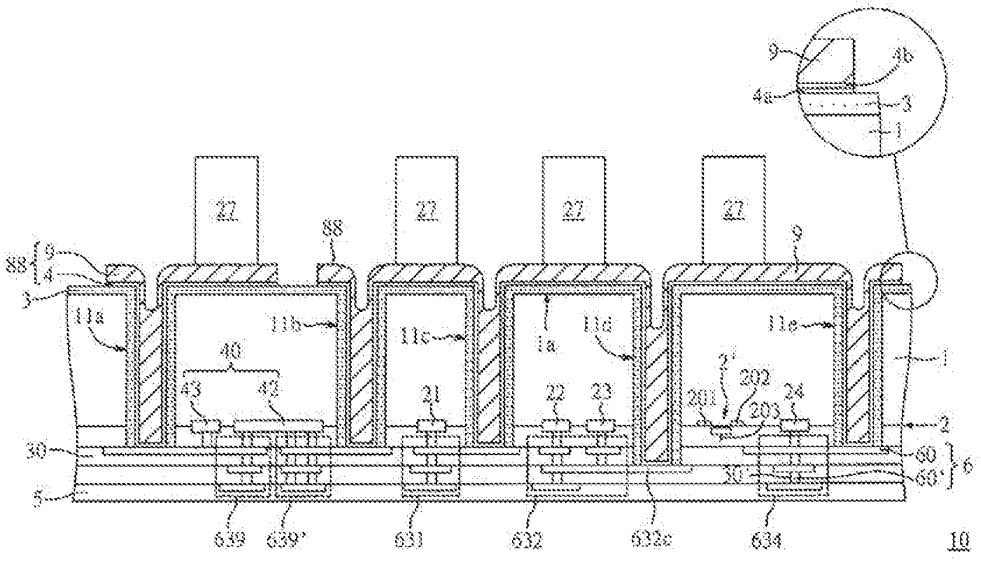


Fig. 26F

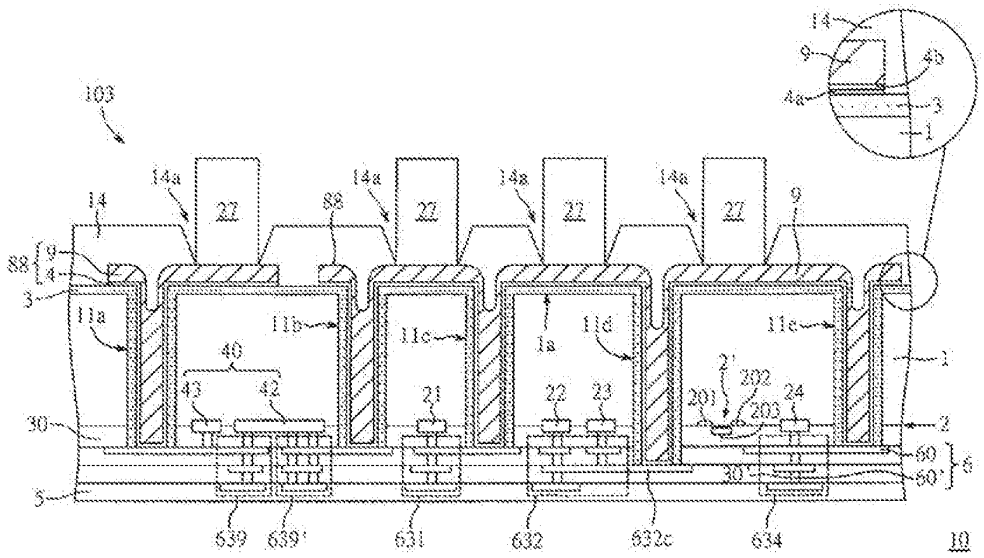


Fig. 26G

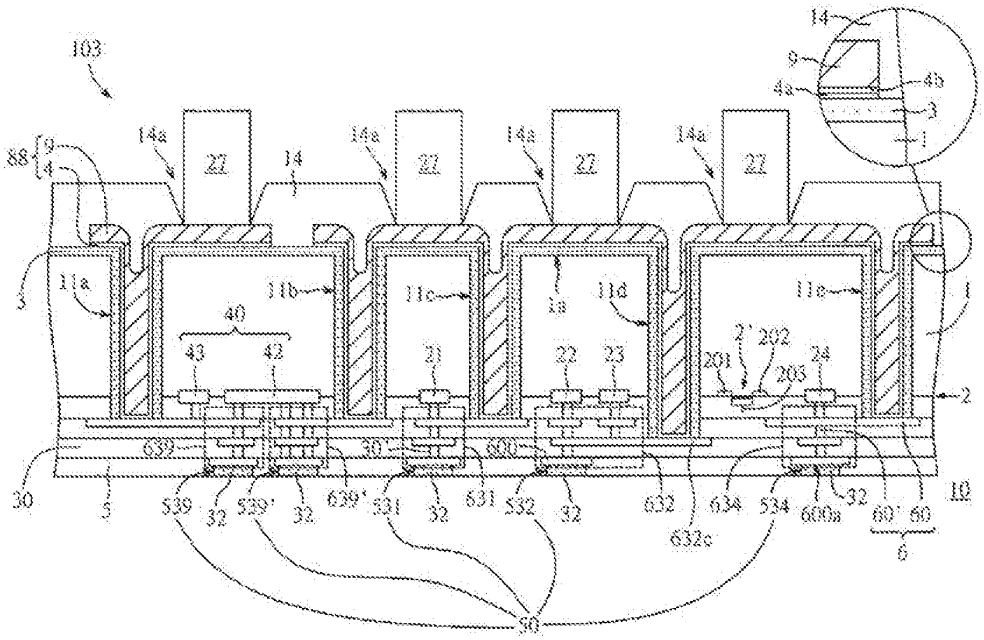


Fig. 26H

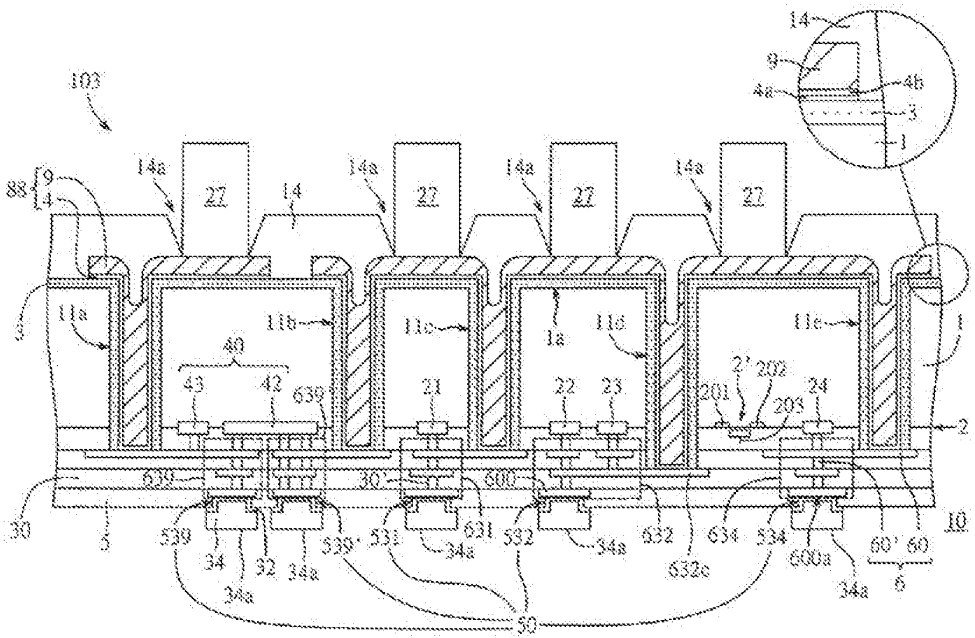


Fig. 26I

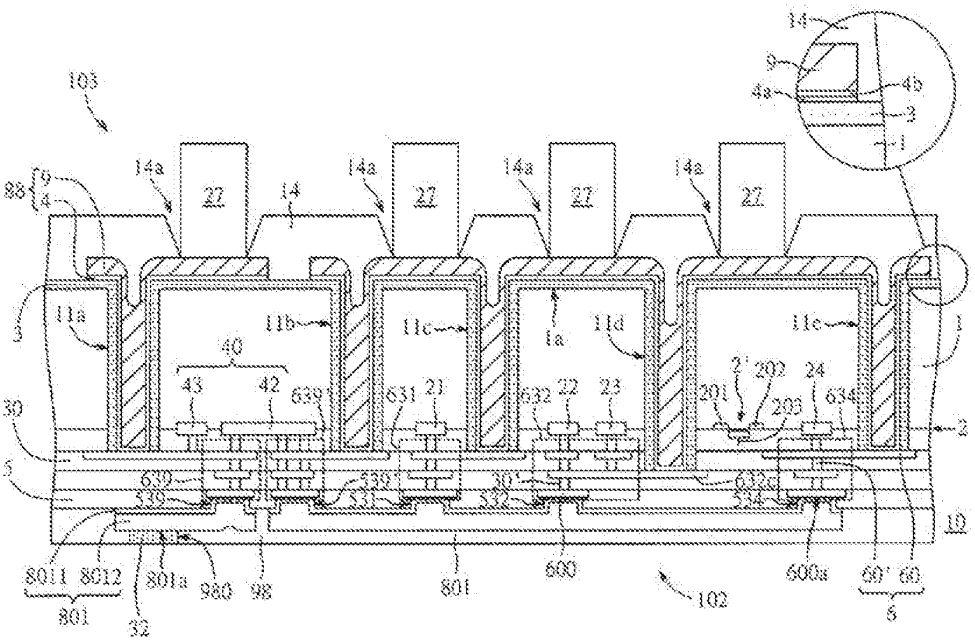


Fig. 26J

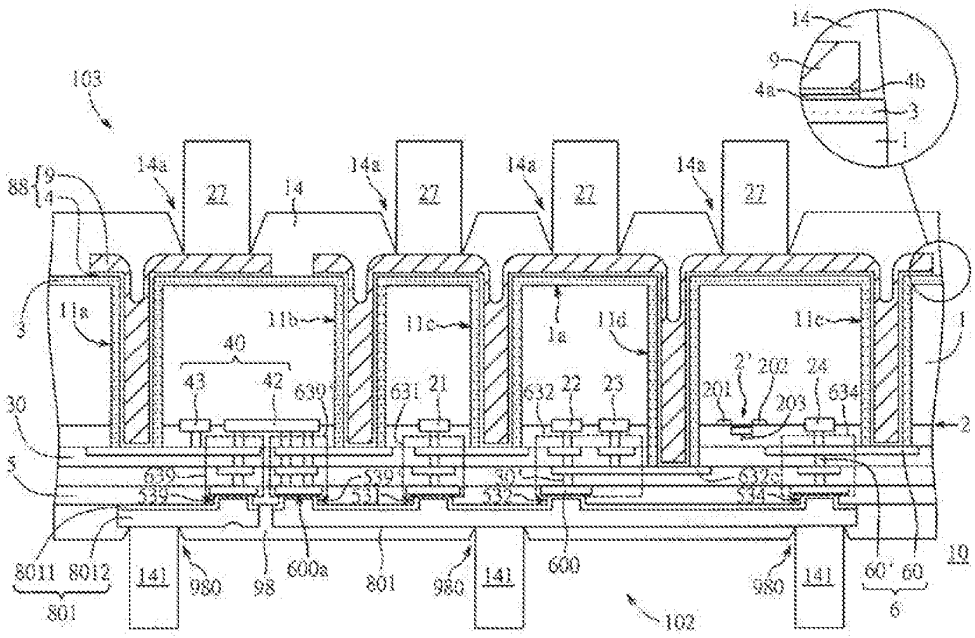


Fig. 26K

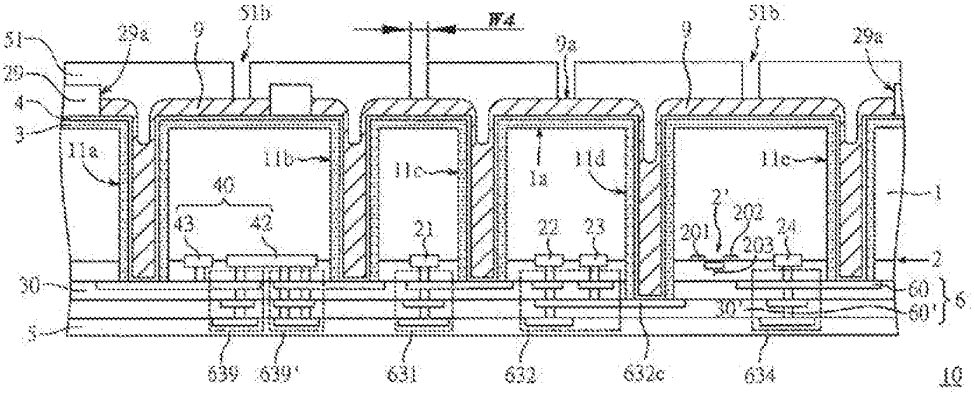


Fig. 27A

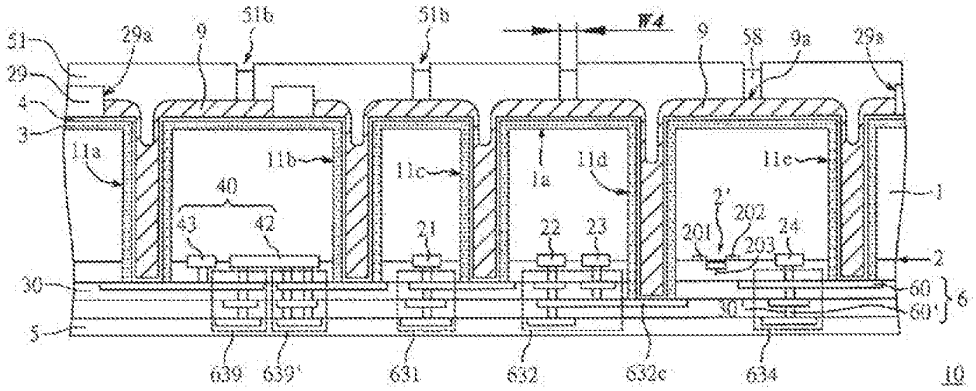


Fig. 27B

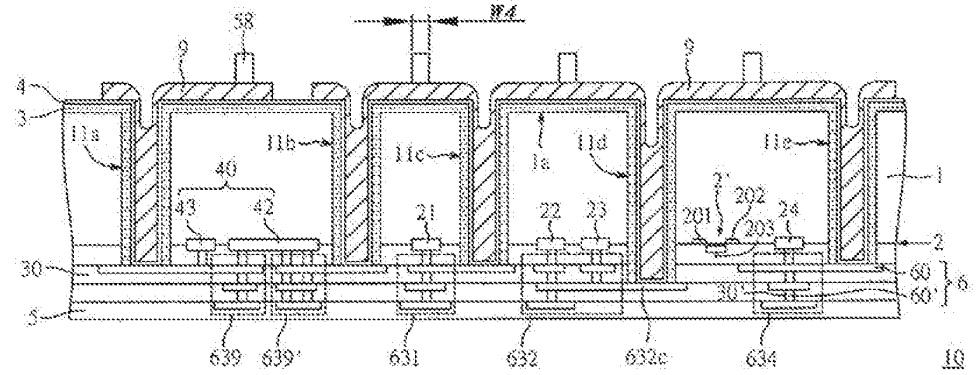


Fig. 27C

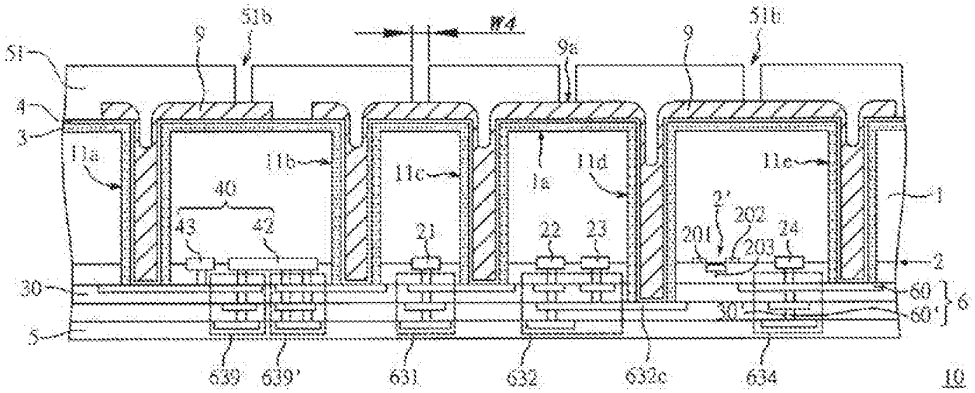


Fig. 27D

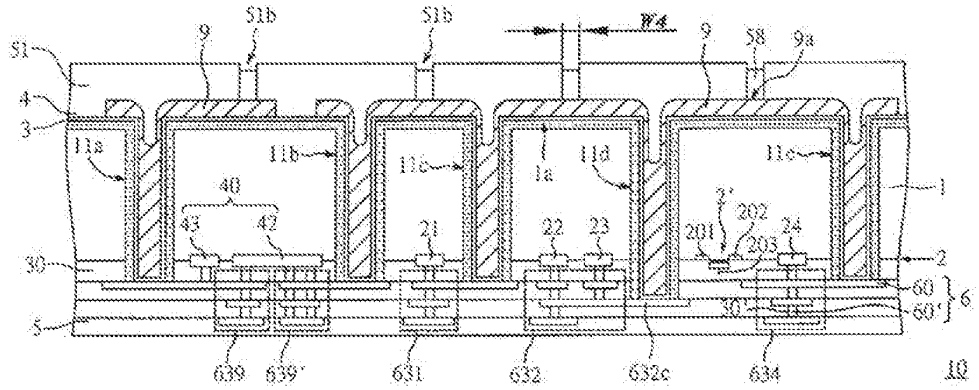


Fig. 27E

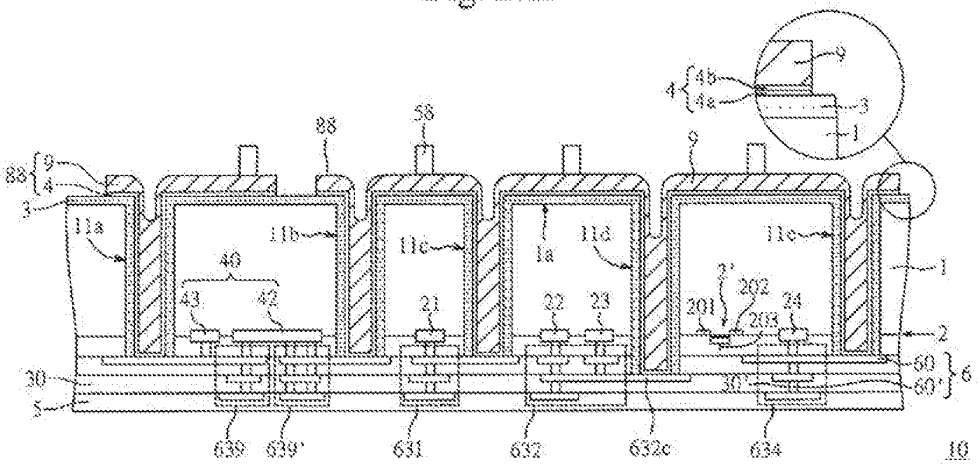


Fig. 27F

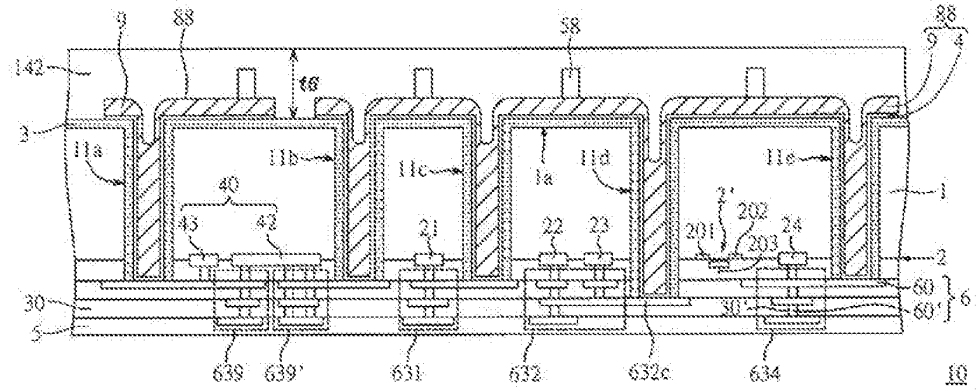


Fig. 27G

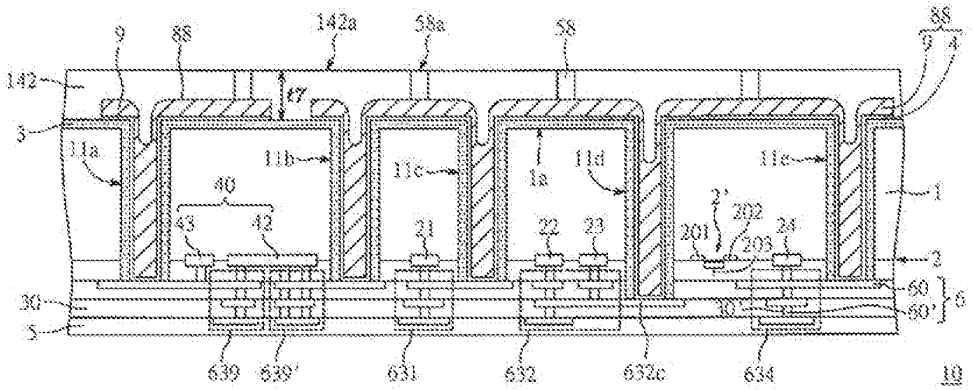


Fig. 27H

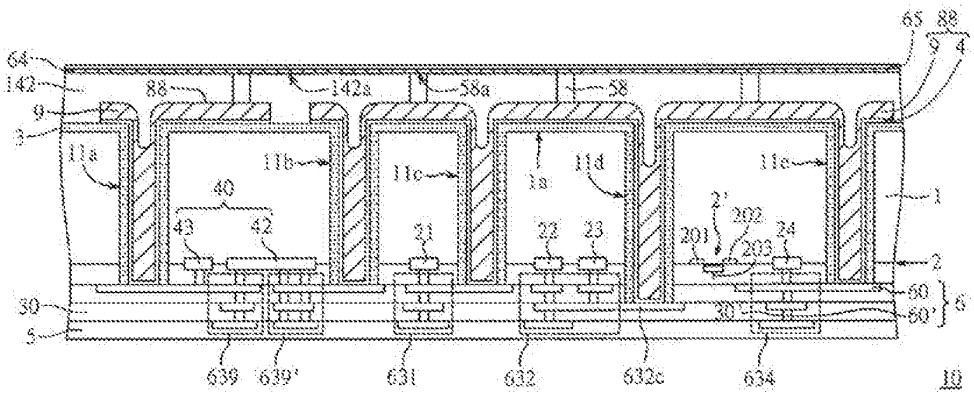


Fig. 27I

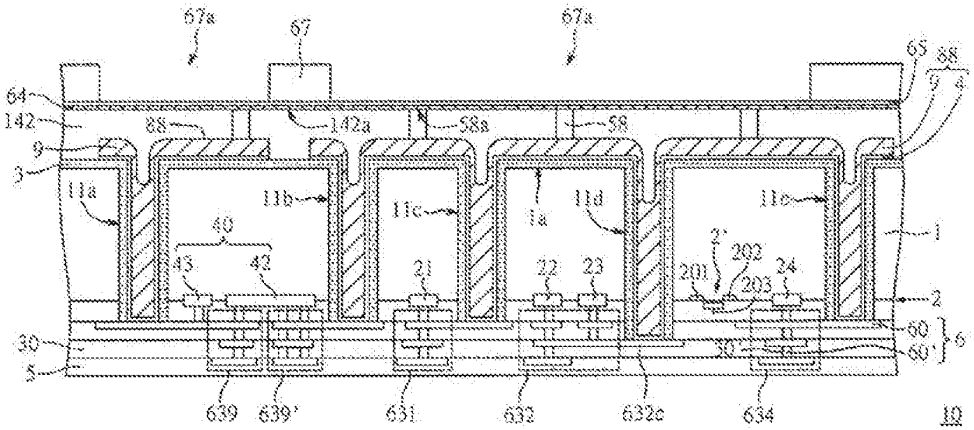


Fig. 27J

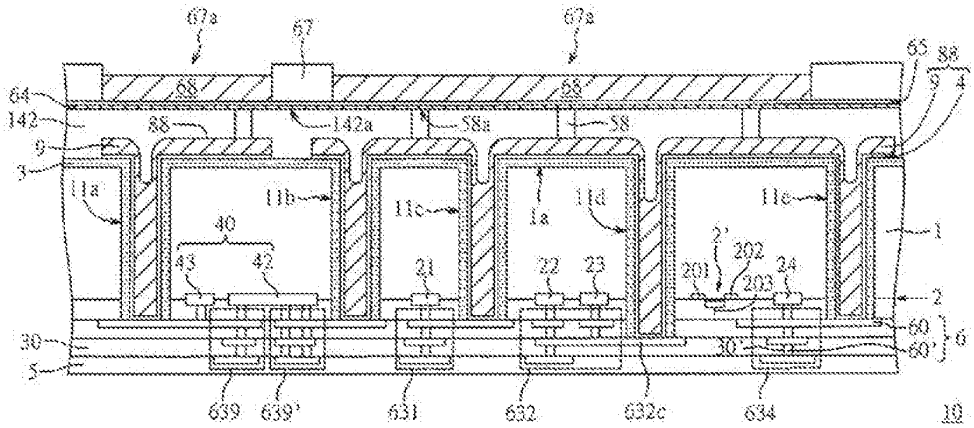


Fig. 27K

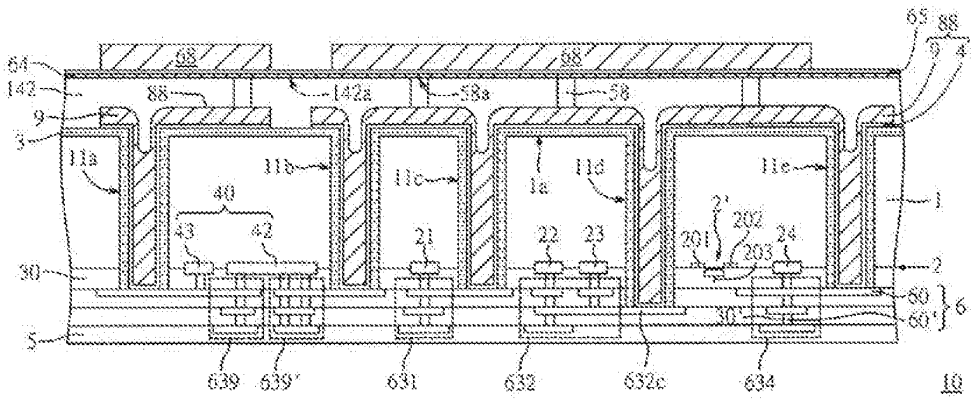


Fig. 27L

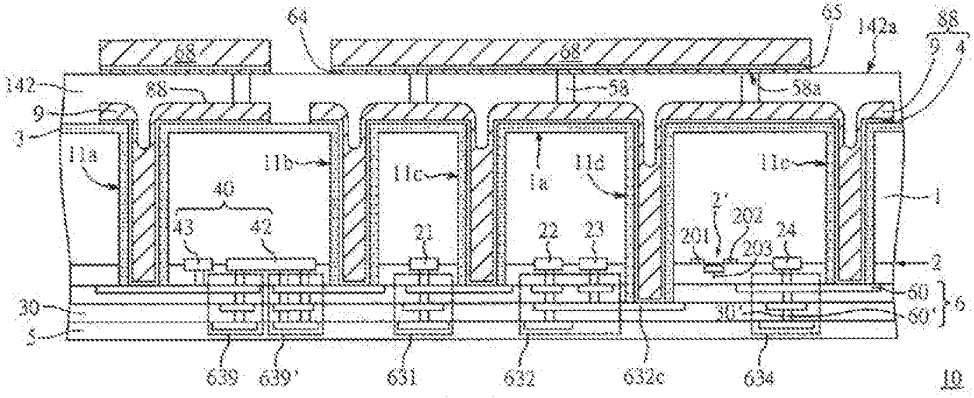


Fig. 27M

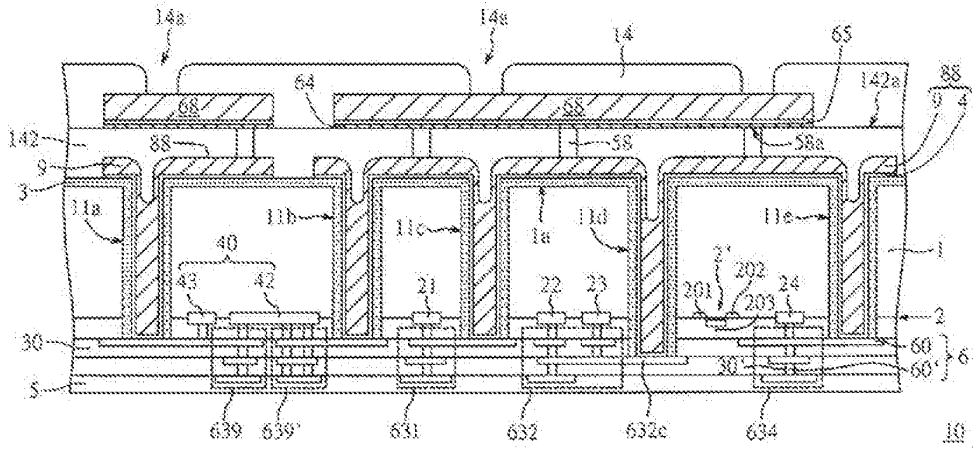


Fig. 27N

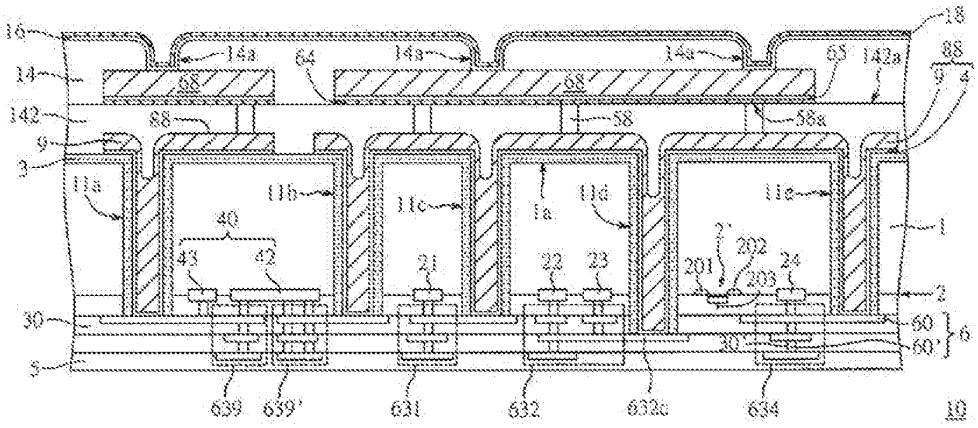


Fig. 27O

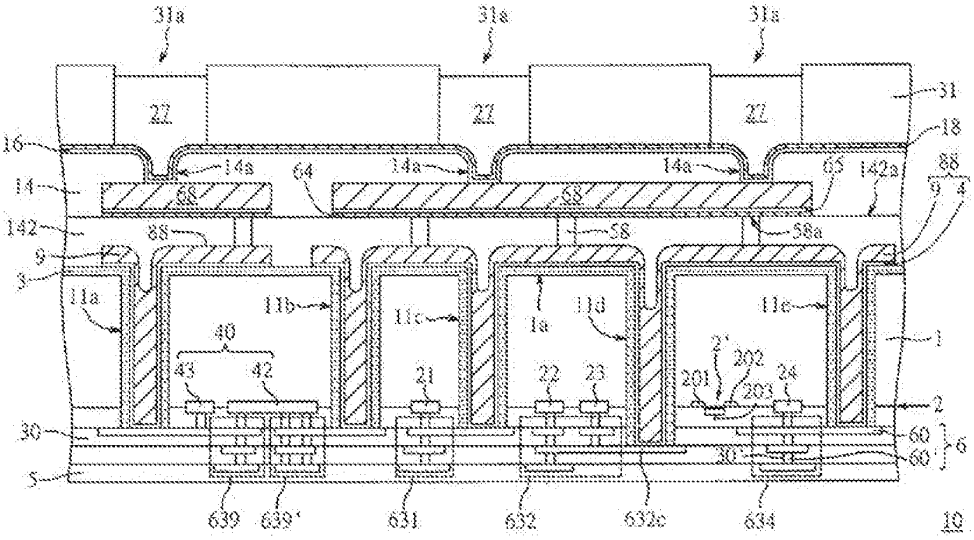


Fig. 27P

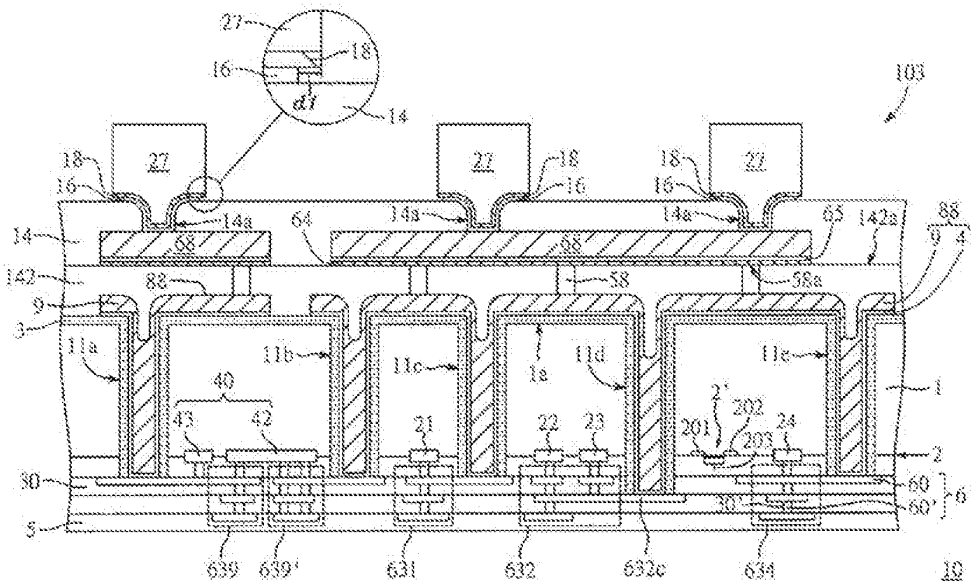


Fig. 27Q

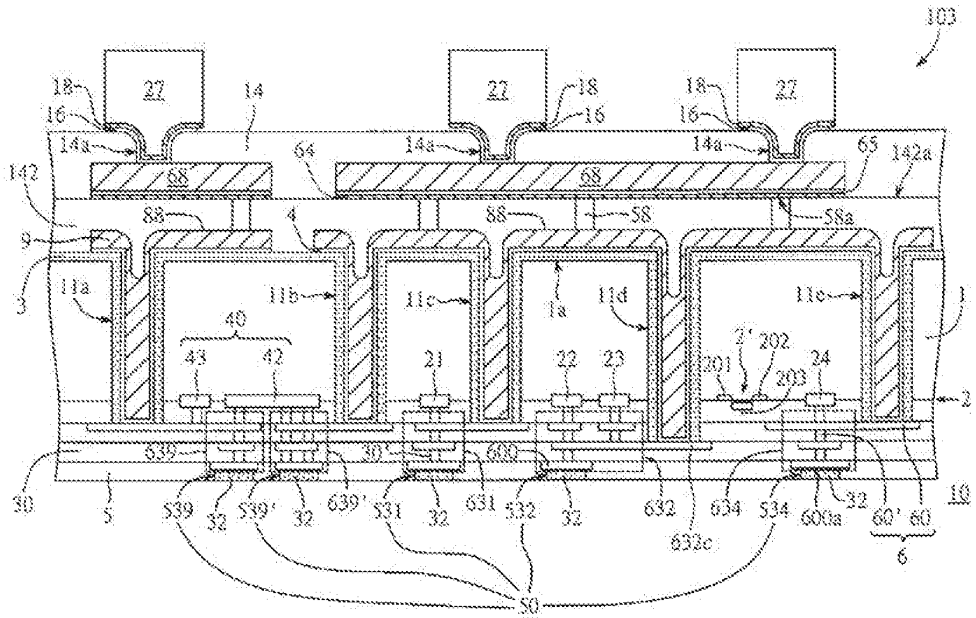


Fig. 27R

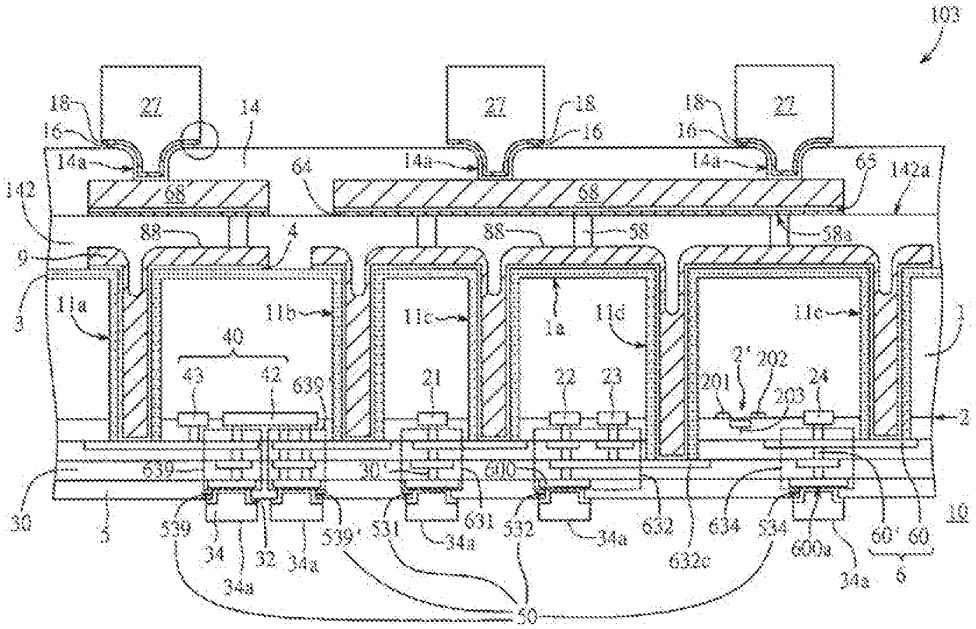


Fig. 27S

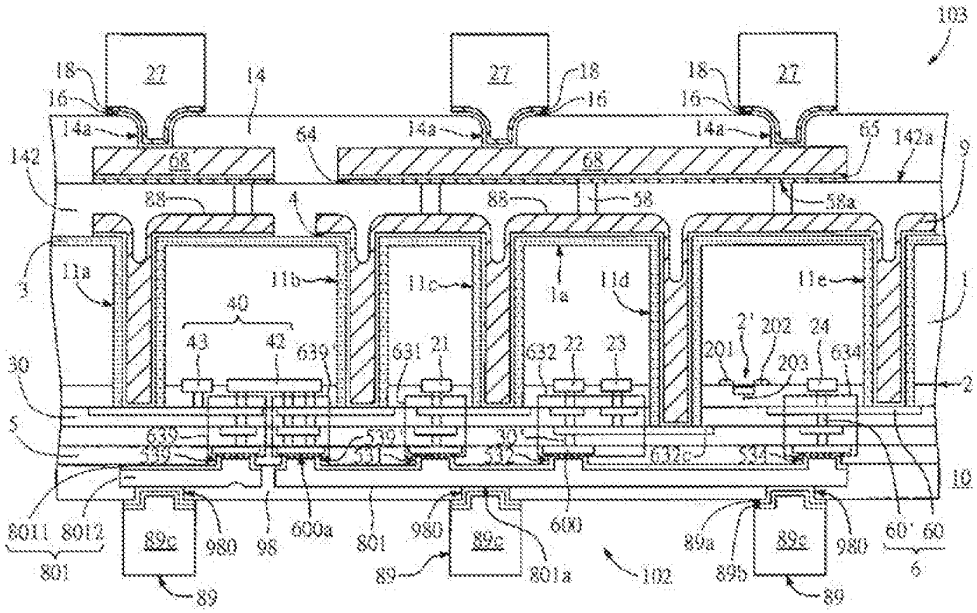


Fig. 27T

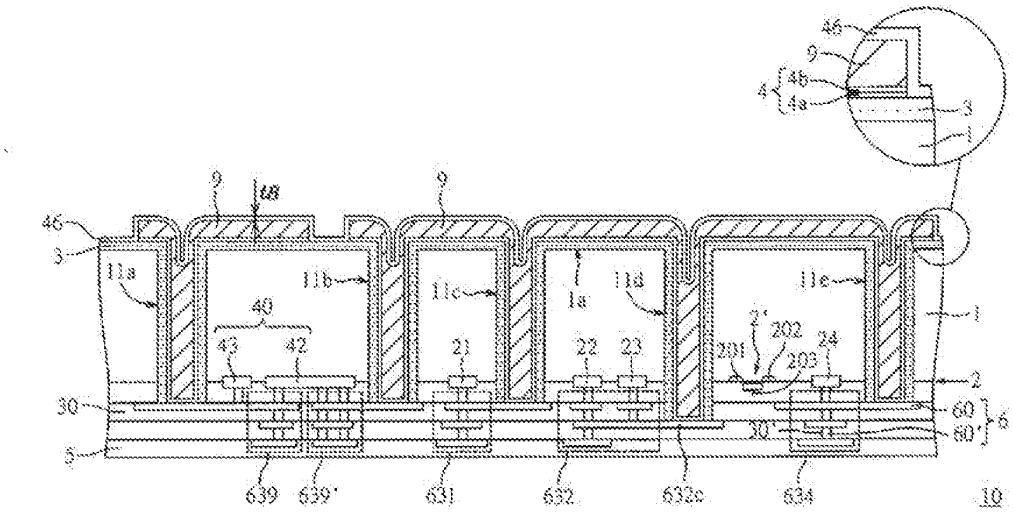


Fig. 28A

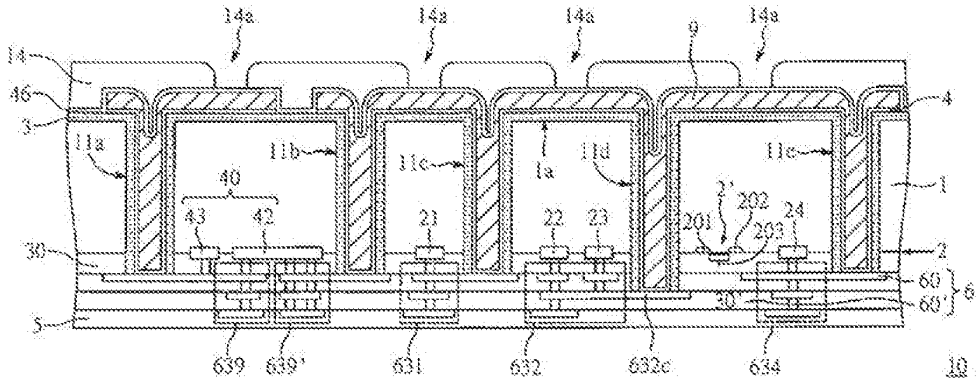


Fig. 28B

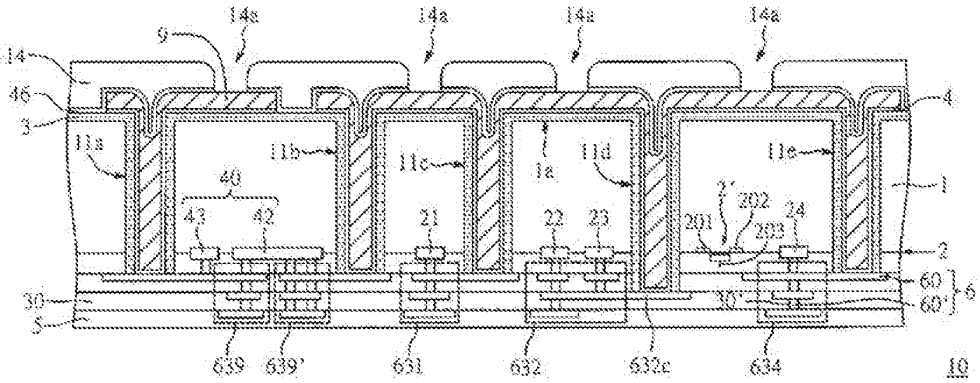


Fig. 28C

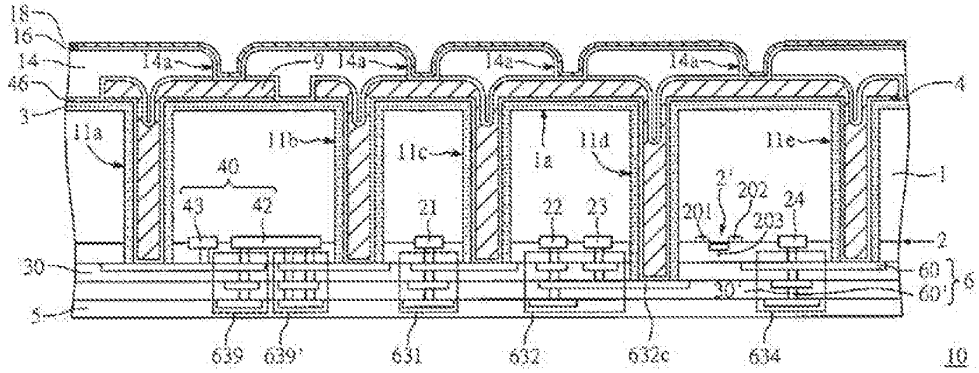


Fig. 28D

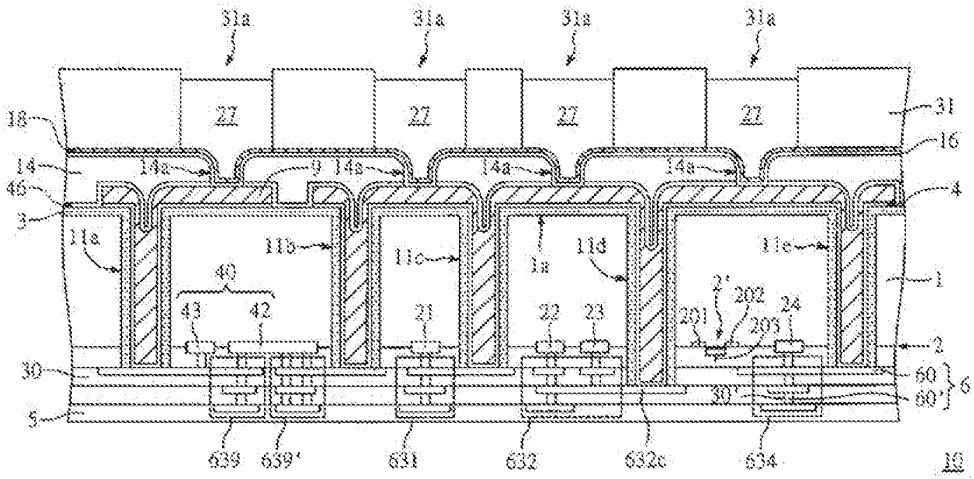


Fig. 28E

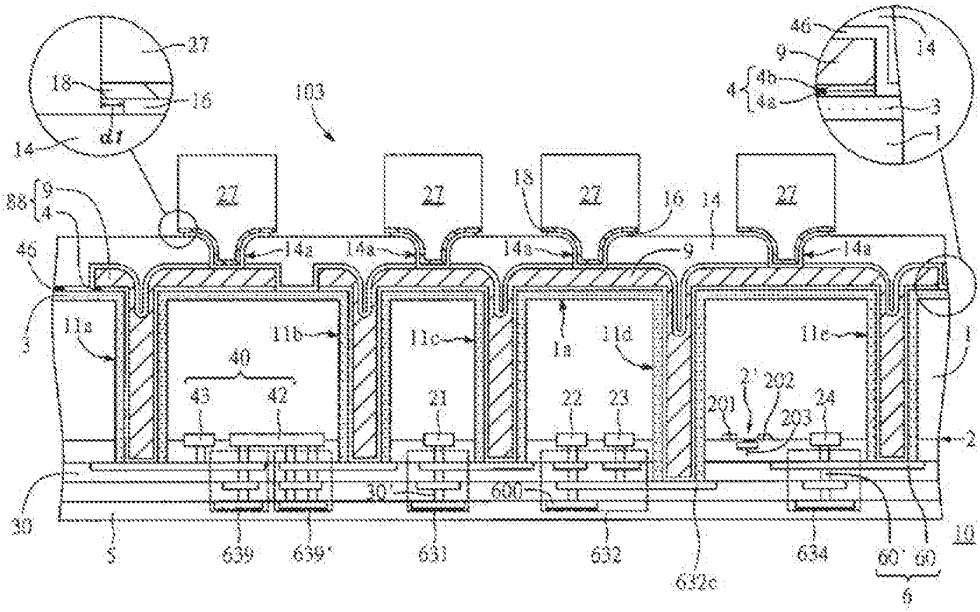


Fig. 28F

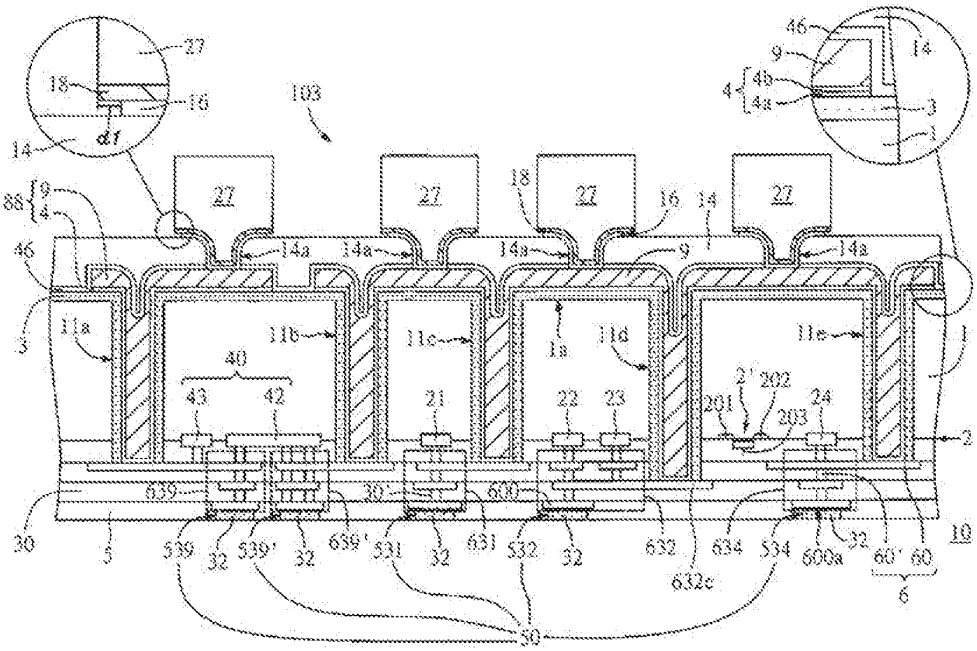


Fig. 28G

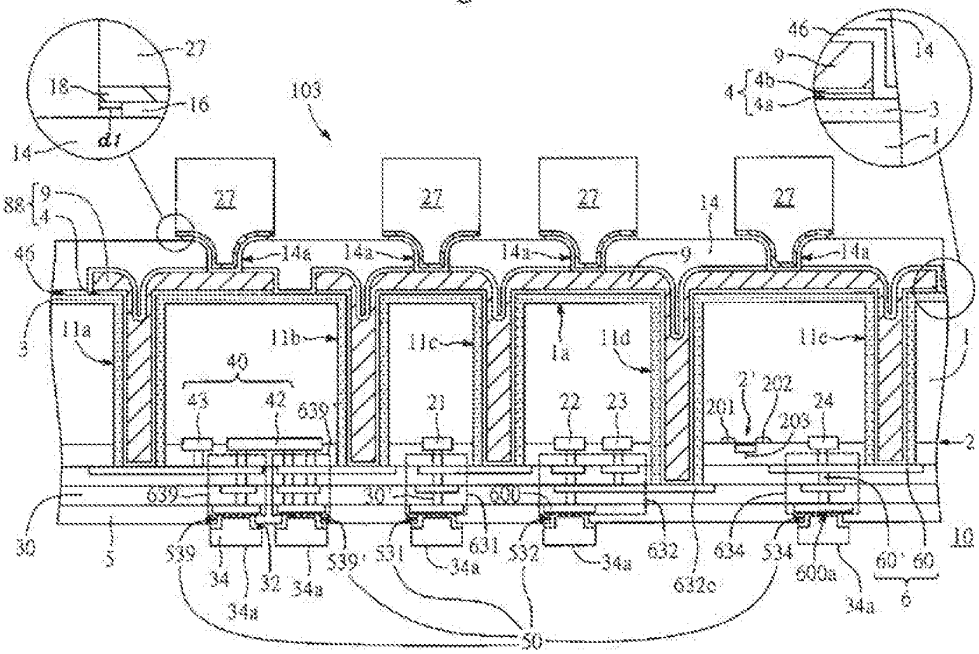


Fig. 28H

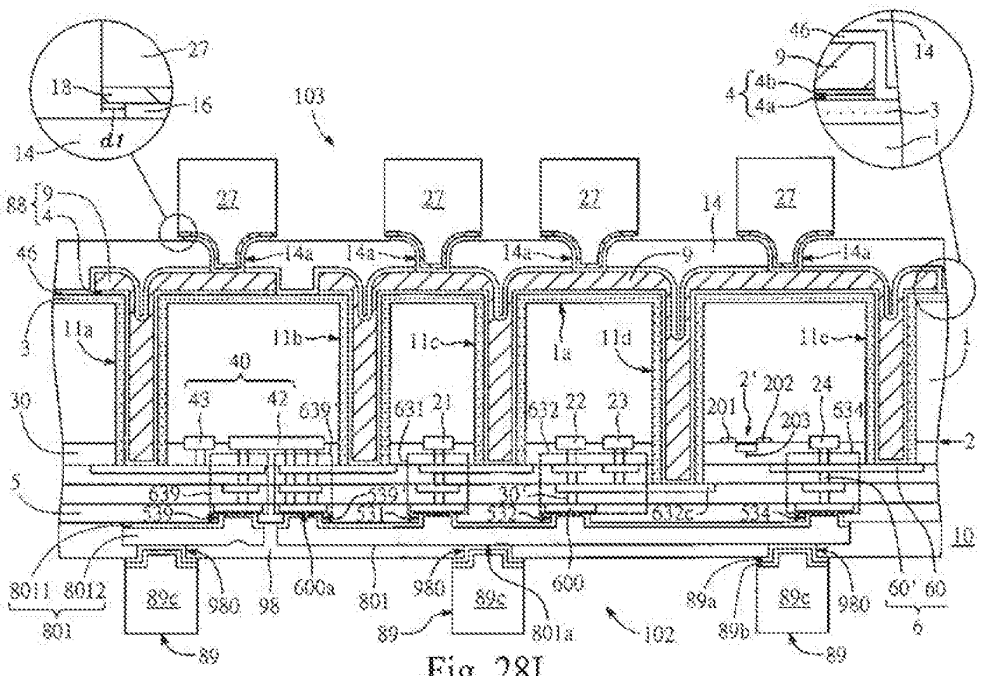


Fig. 28I

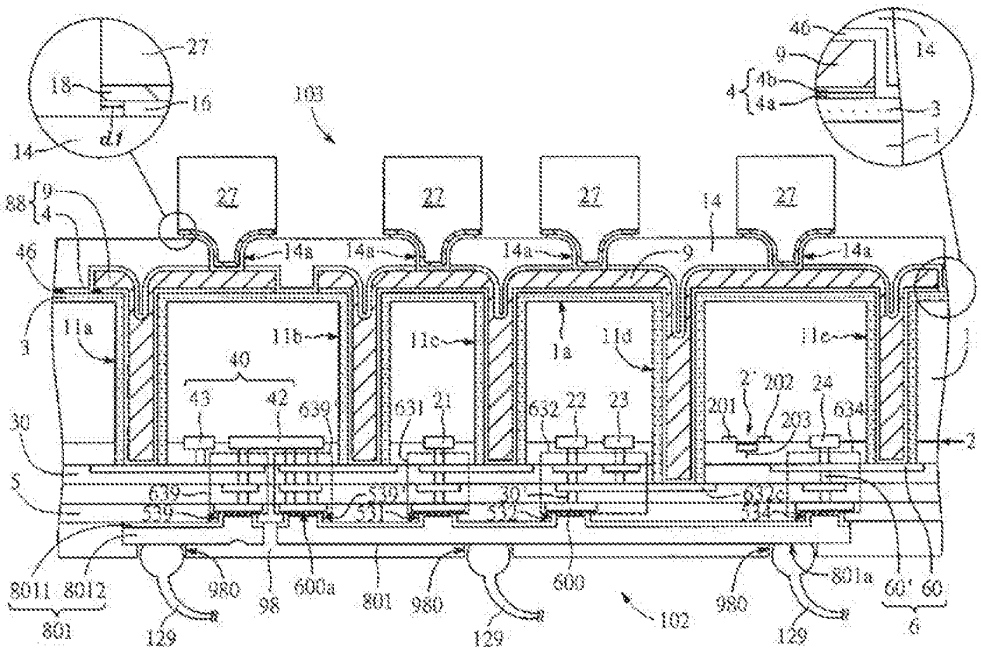
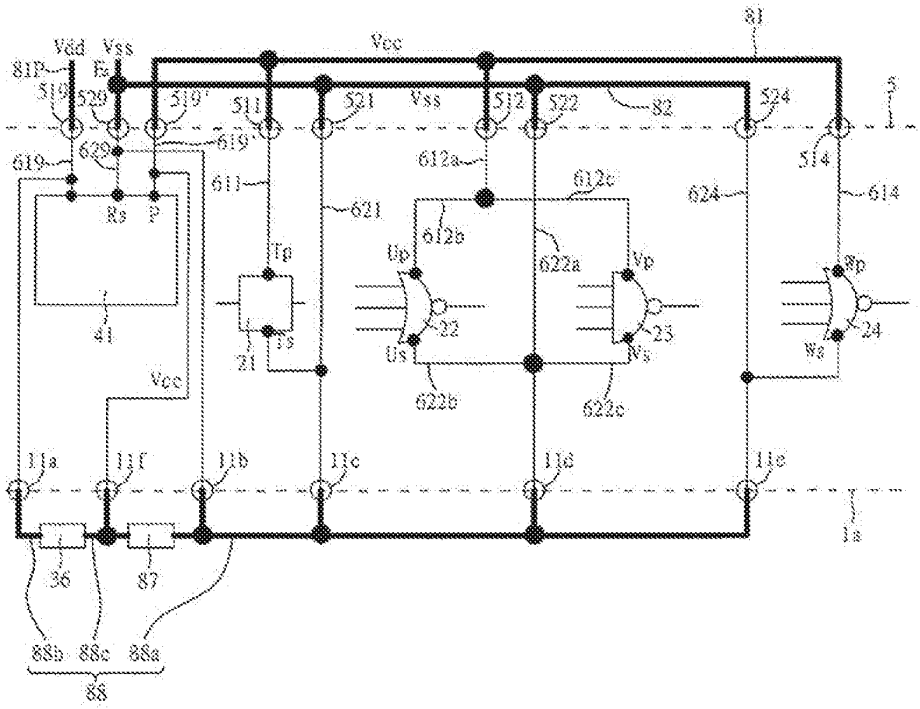


Fig. 28J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Vss
Vcc
81P
Rs
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510'
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521
Vss
512
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82
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619
620
619'
611
621
612a
612c
624
614
514
Rp
P
612b
622a
Tp
Up
Vp
Wp
41
21
Ts
22
23
24
Us
Ws
622b
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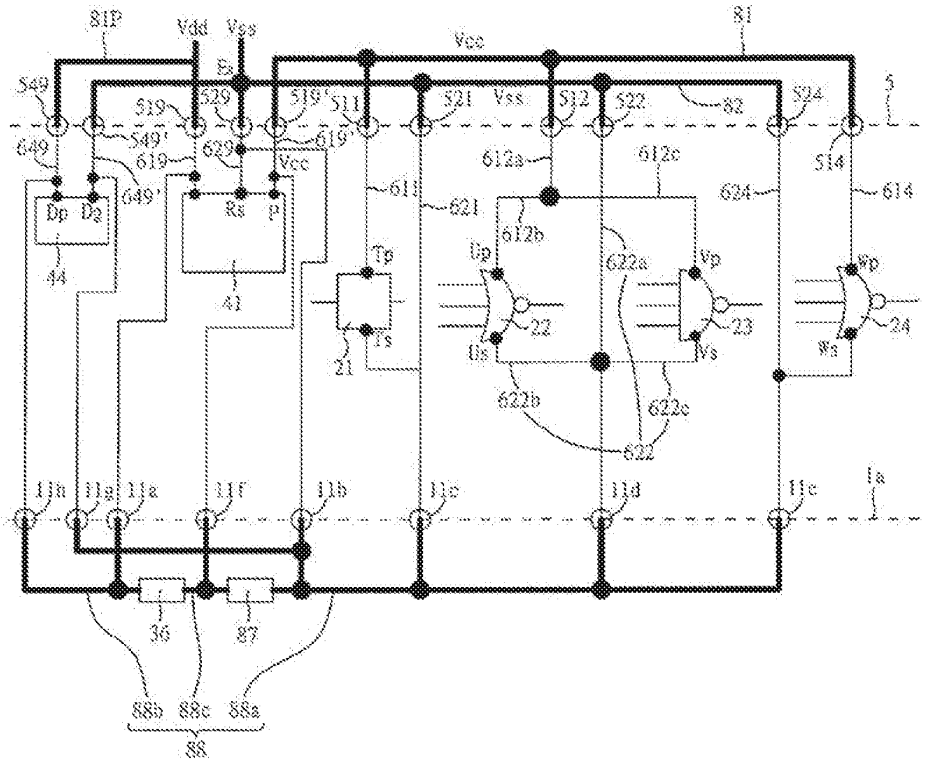
36
87
88b
88c
88a
88

Fig. 29A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5
649
549'
619
629
619'
Vcc
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612c
514
624
614
649'
Rs
P
611
621
612b
Dp
D2
Tp
Up
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Wp
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23
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21
Ts
Us
Vs
Ws
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622c
622
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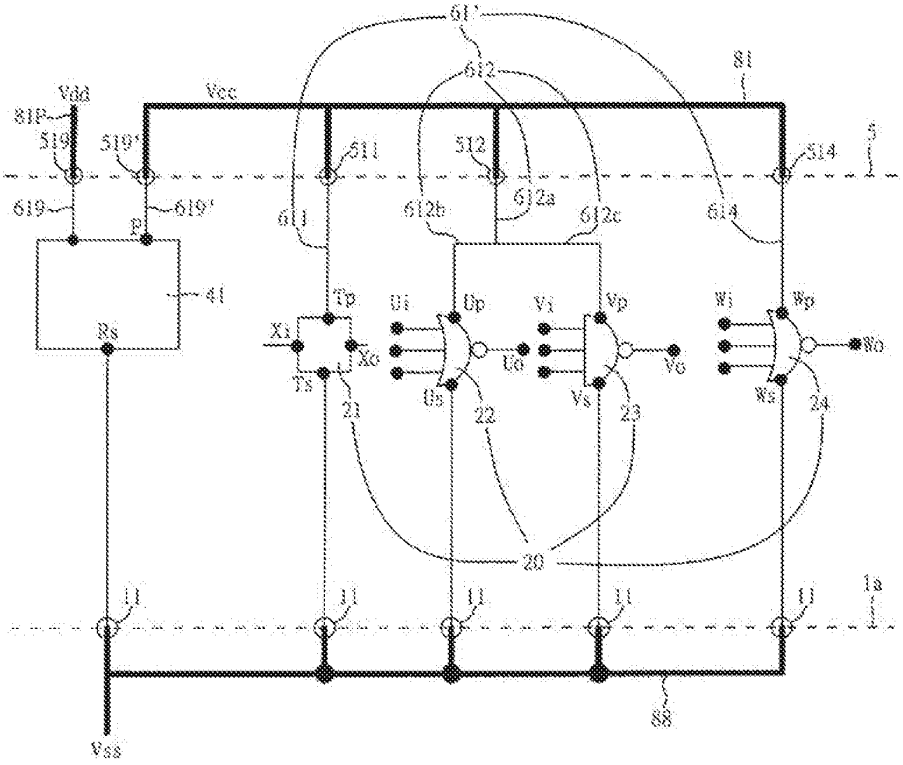
88a
88

Fig. 29B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619'
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612b
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612c
614
P
41
Rs
Xp
Xi
Xc
Xs
Up
Ui
Uc
Us
Vi
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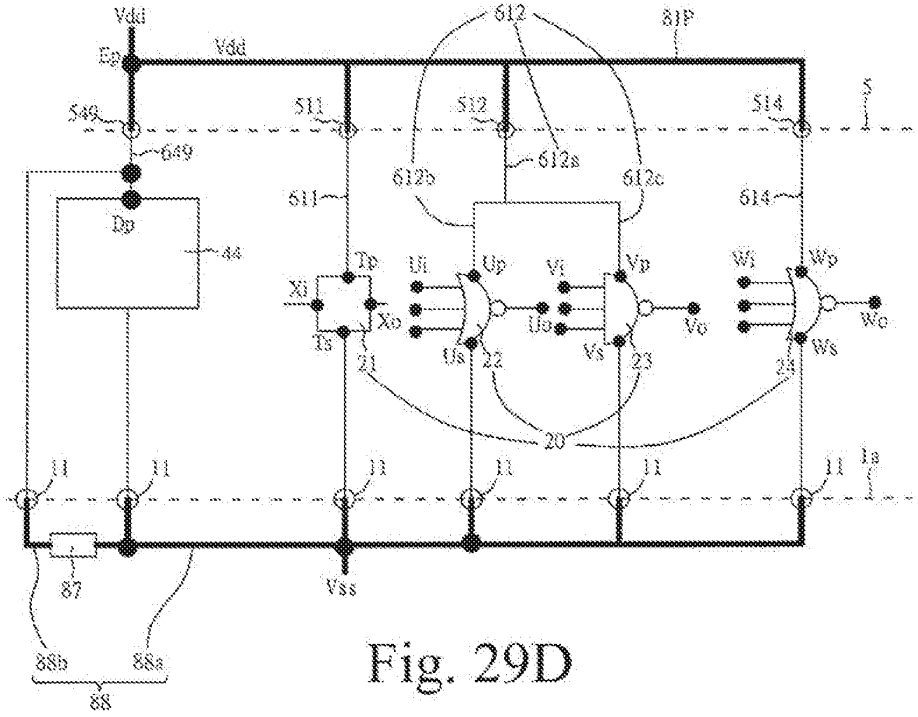
Vss

Fig. 29C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Ui
Up
Vi
Vp
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Xo
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Vss
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88a
88

Fig. 29D

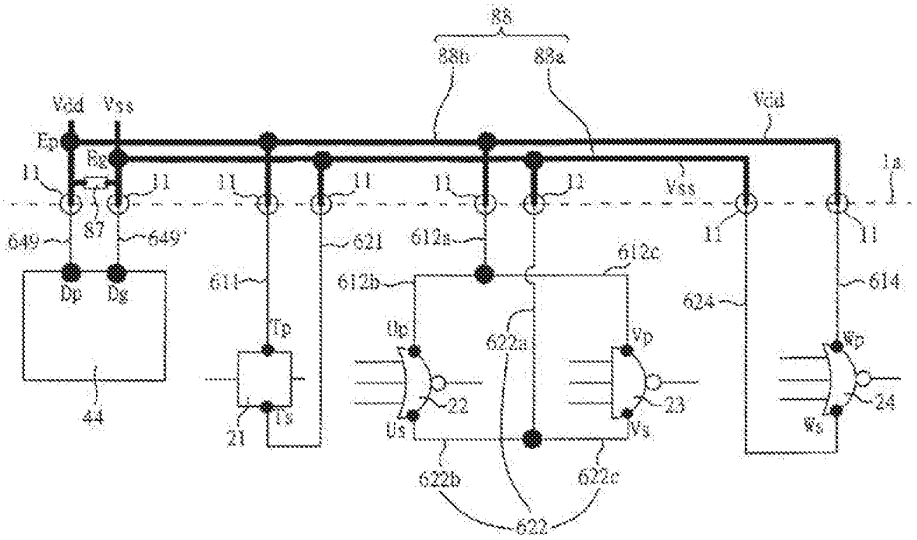


Fig. 29E

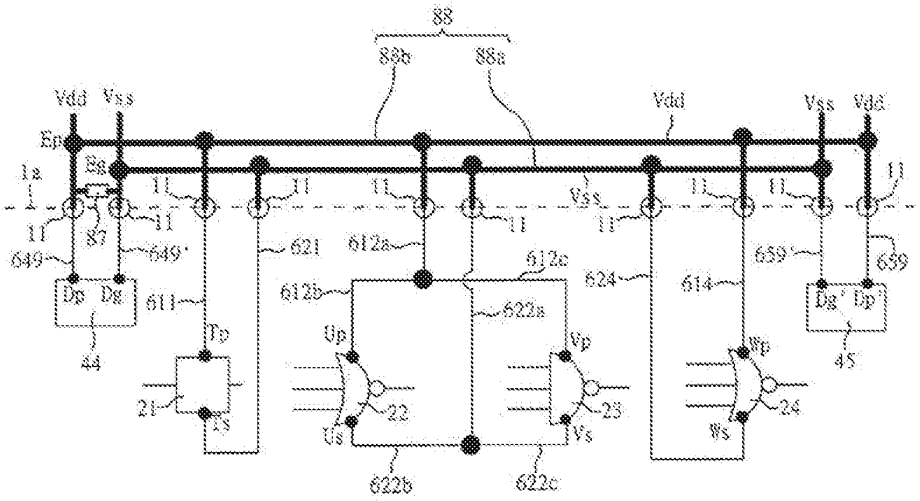


Fig. 29F

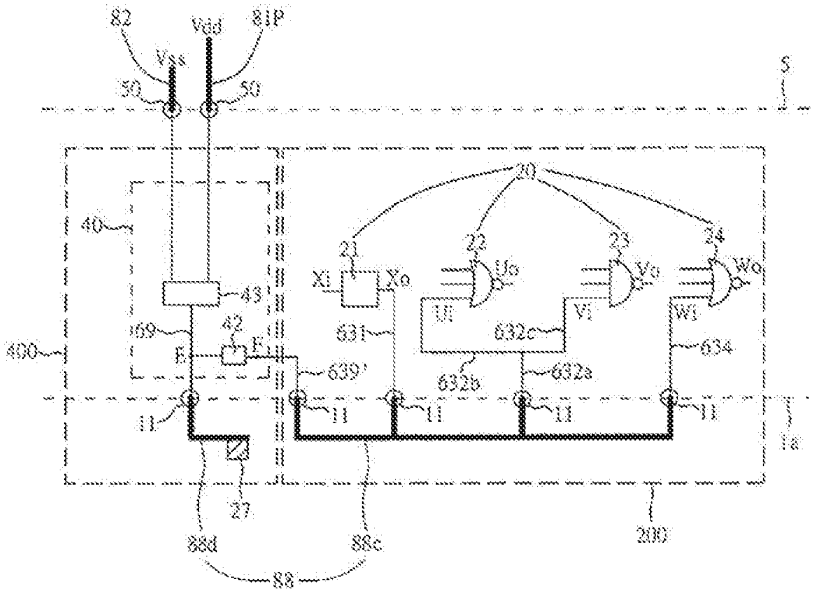


Fig. 29G

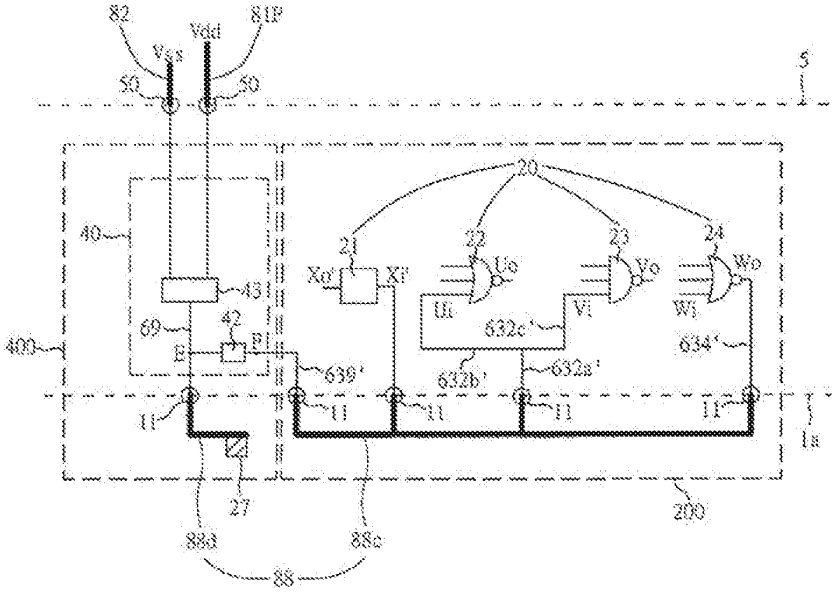


Fig. 29H

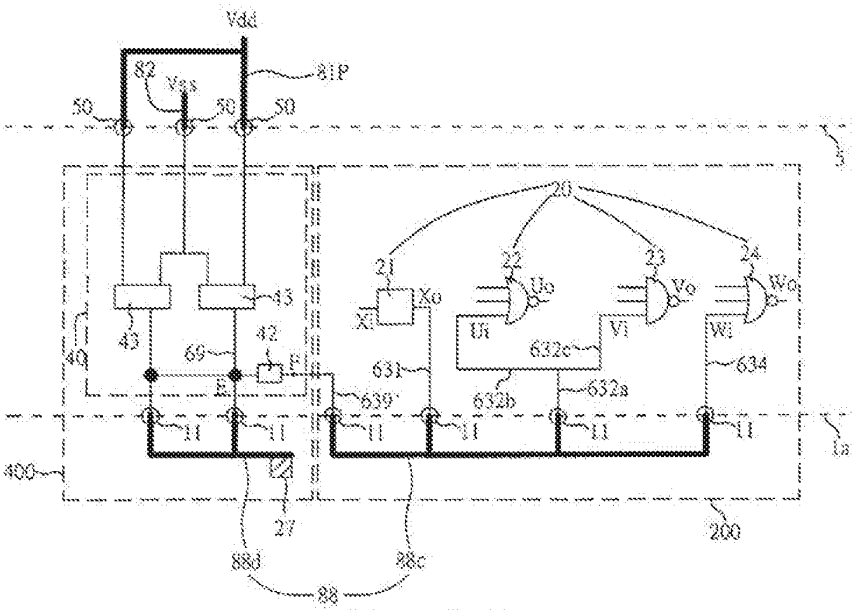


Fig. 29I

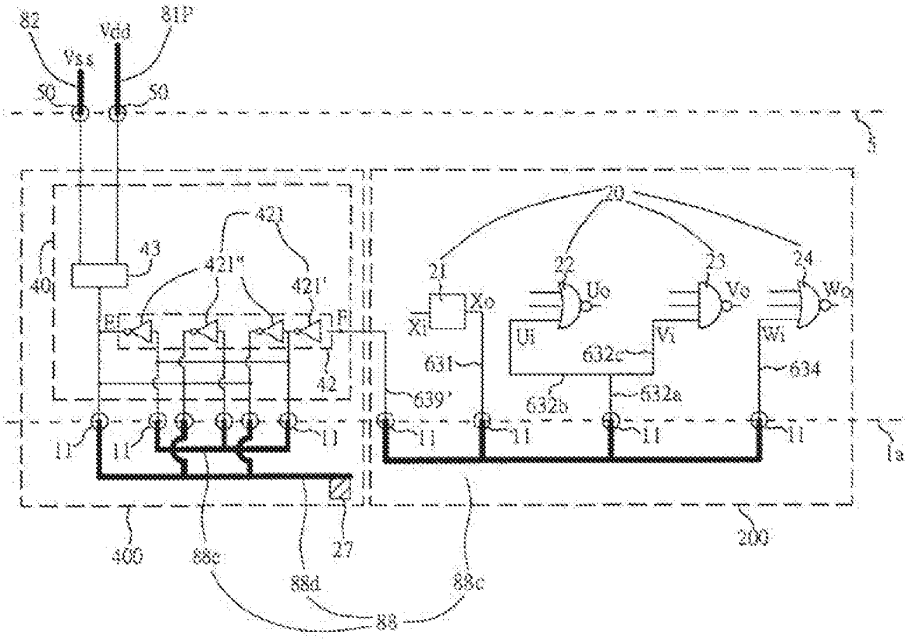


Fig. 29J

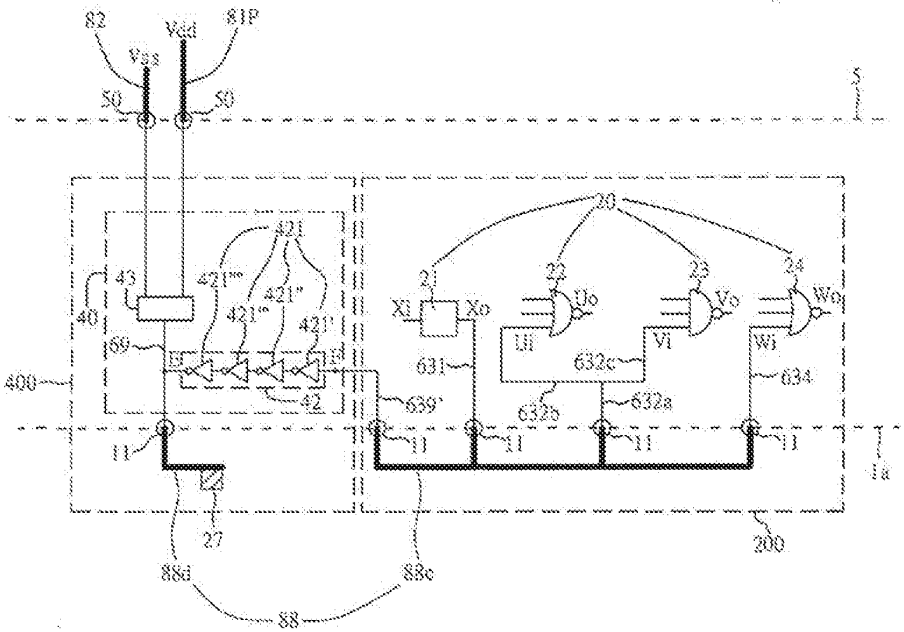


Fig. 29K

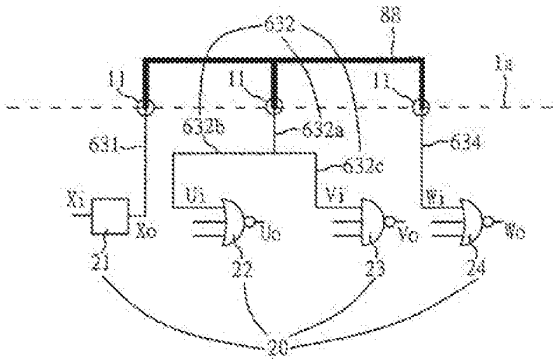


Fig. 29L

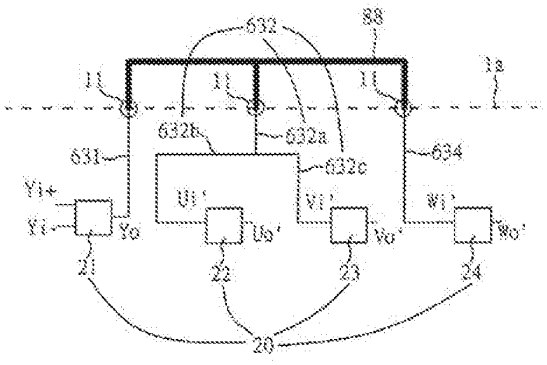


Fig. 29M

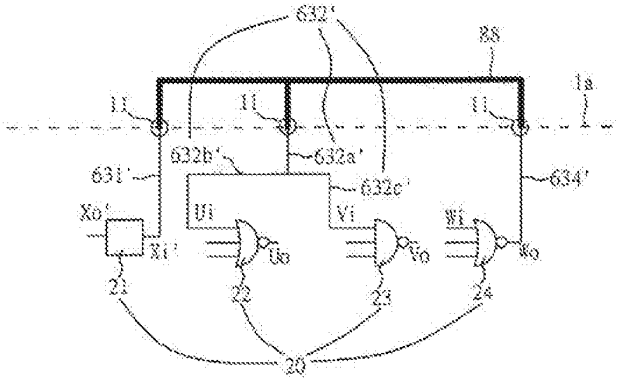


Fig. 29N

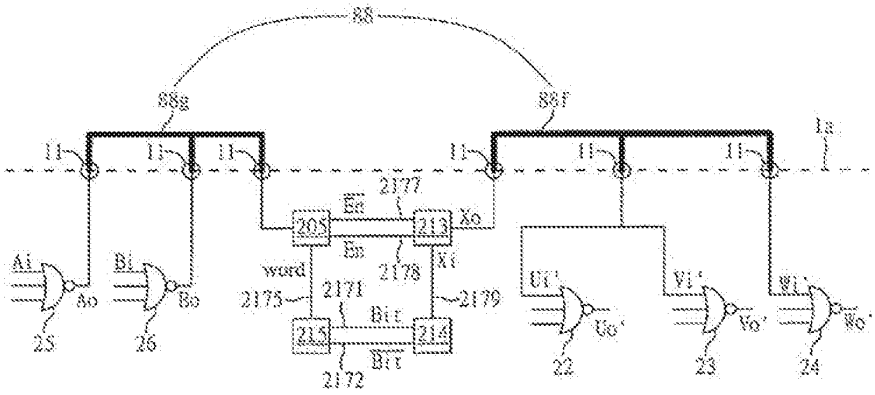


Fig. 29O

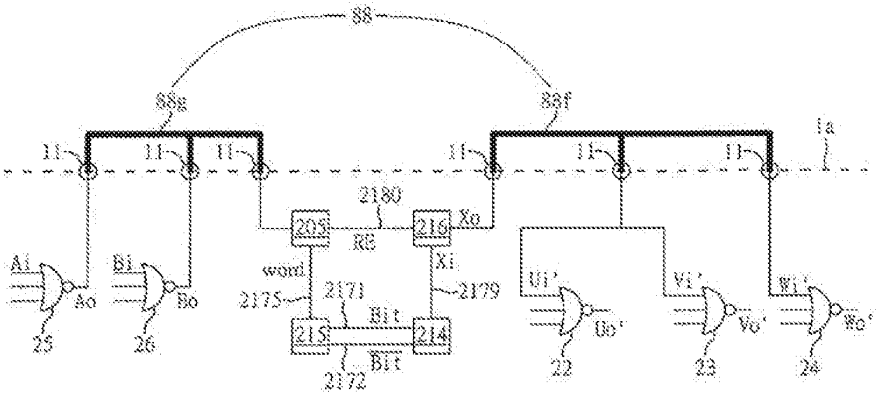


Fig. 29P

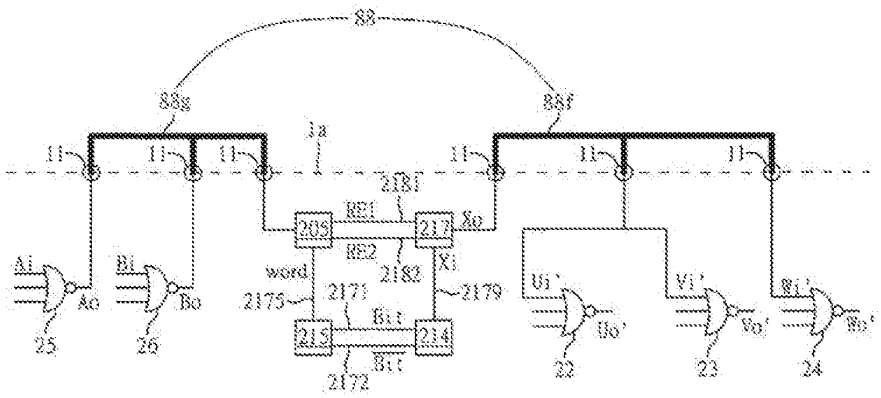


Fig. 29Q

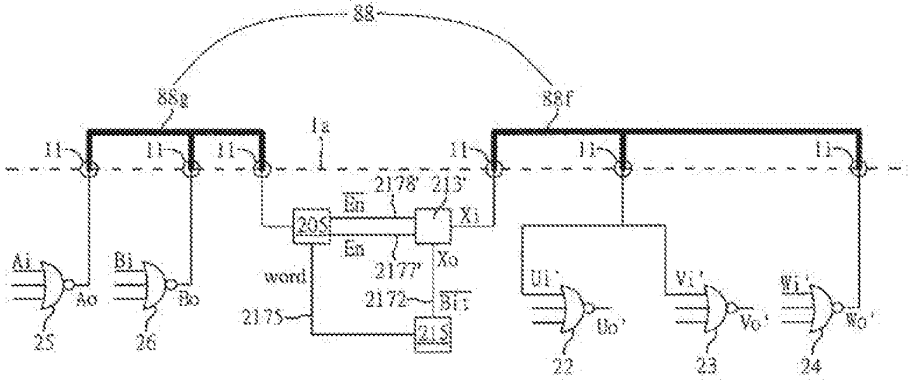


Fig. 29R

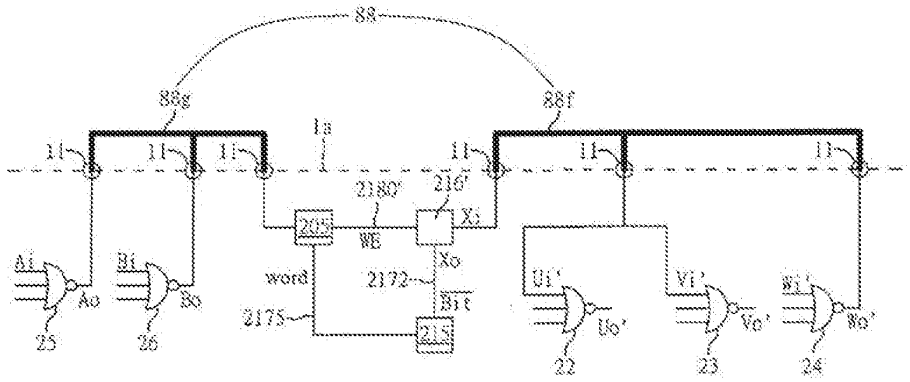


Fig. 29S

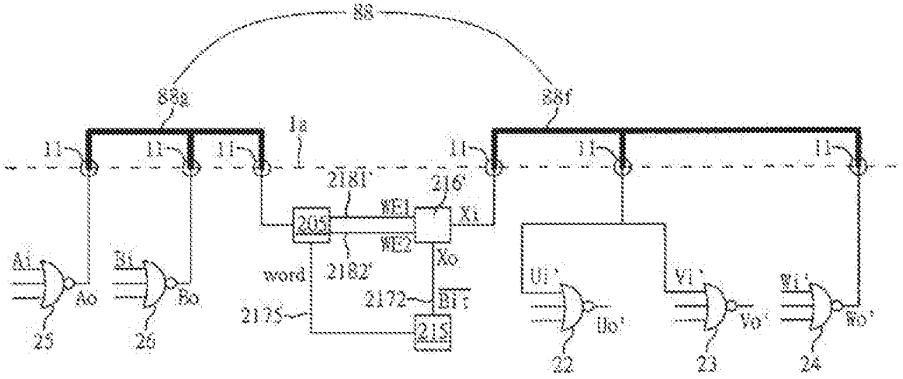


Fig. 29T

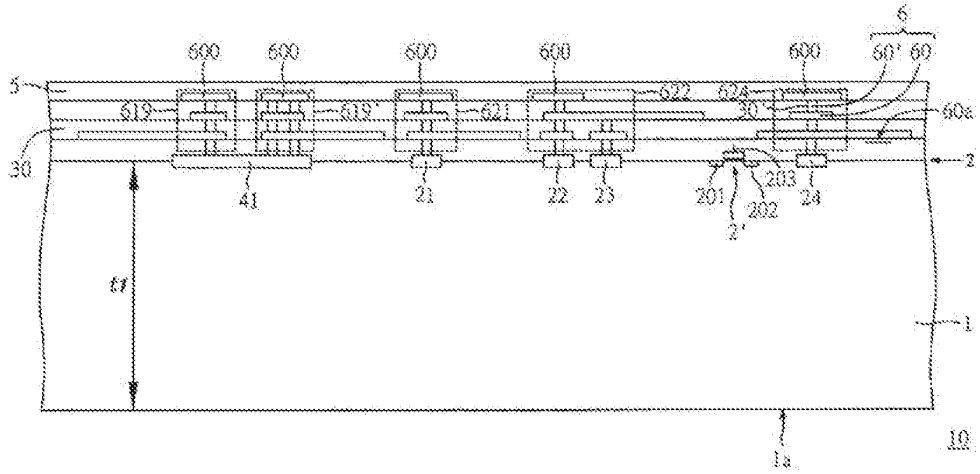


Fig. 30A

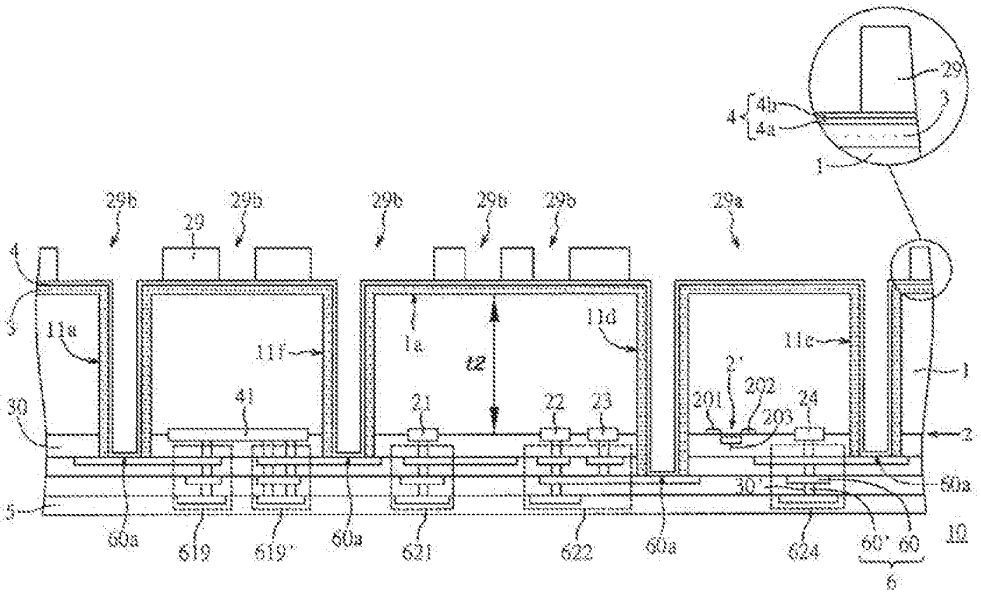


Fig. 30B

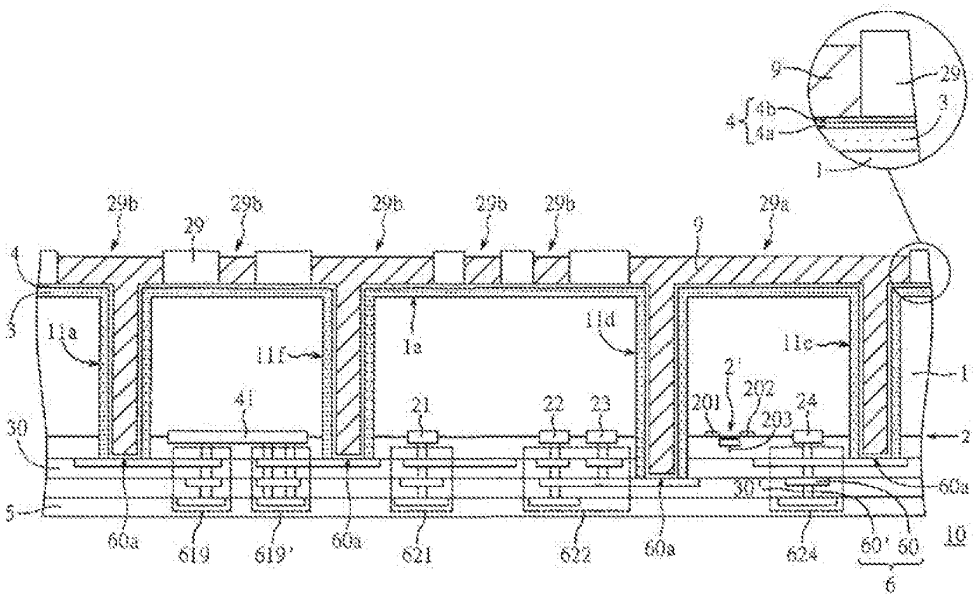


Fig. 30C

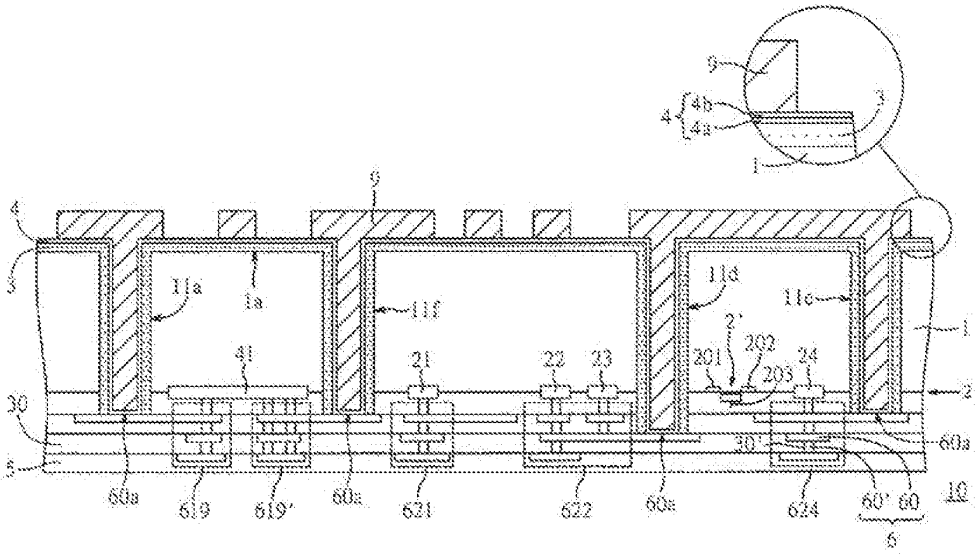


Fig. 30D

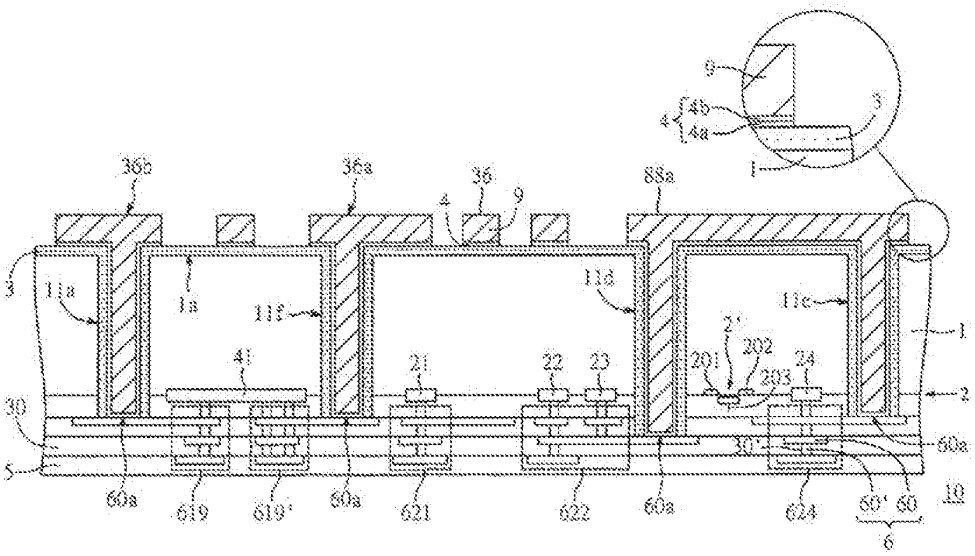


Fig. 30E

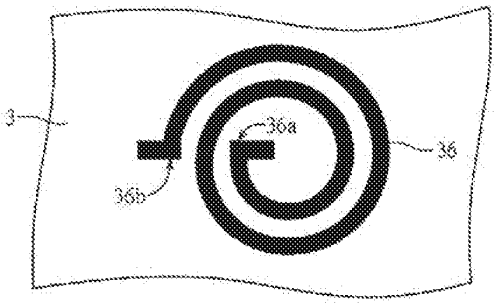


Fig. 30F

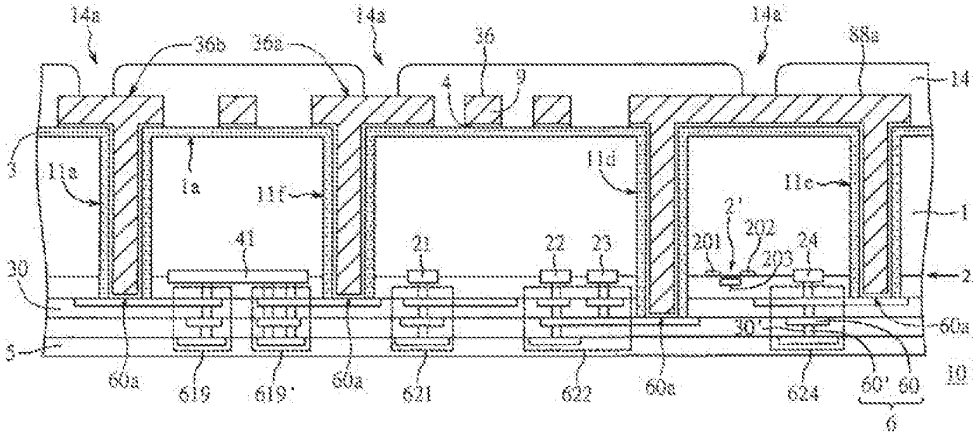


Fig. 30G

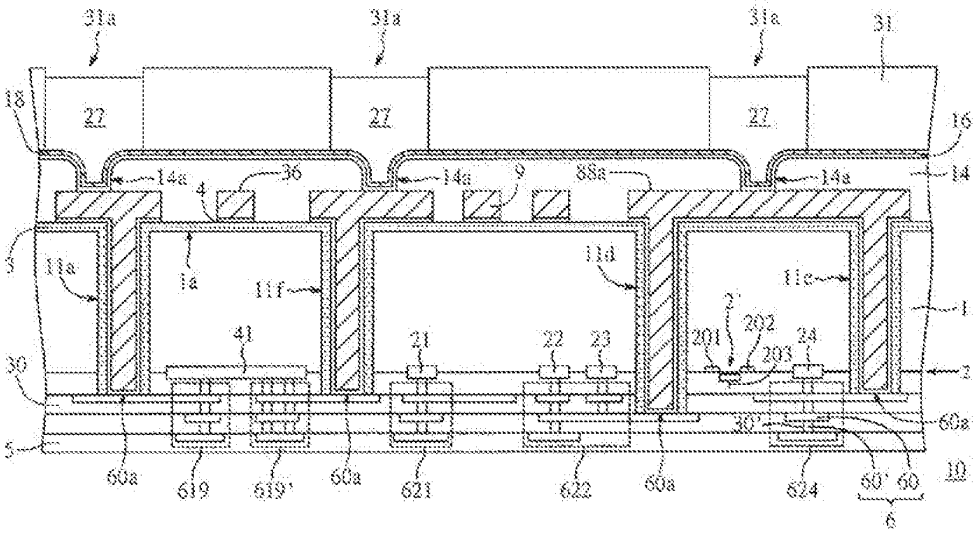


Fig. 30H

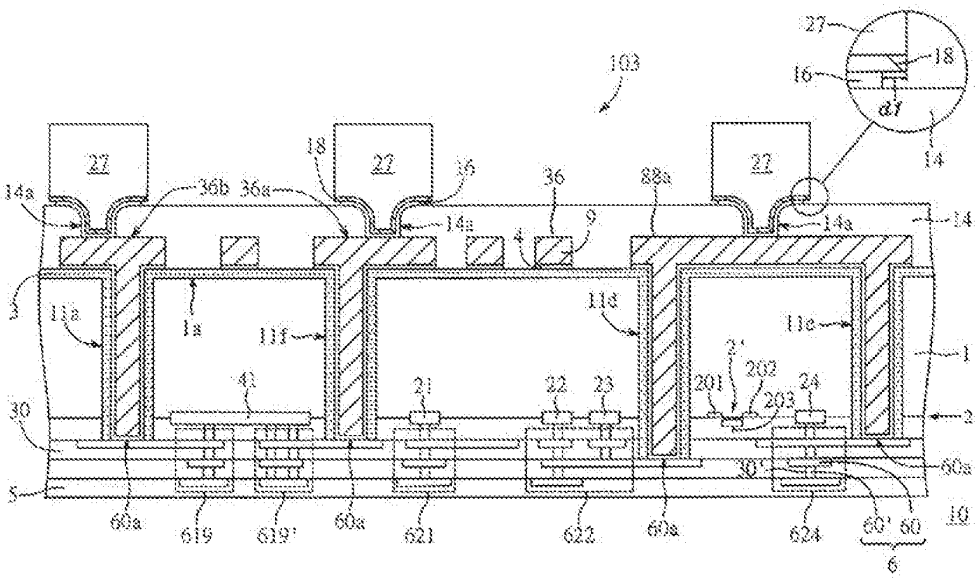


Fig. 30I

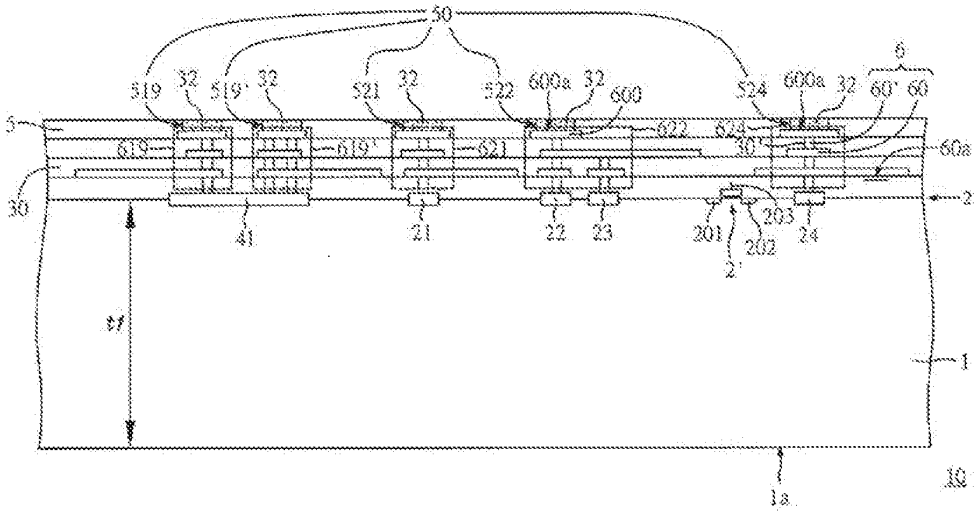


Fig. 30J

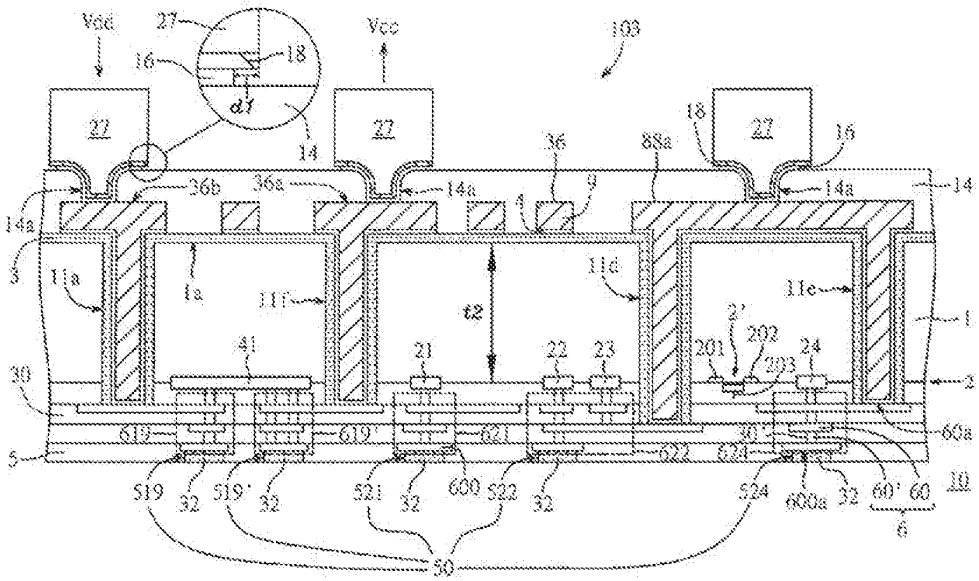


Fig. 30K

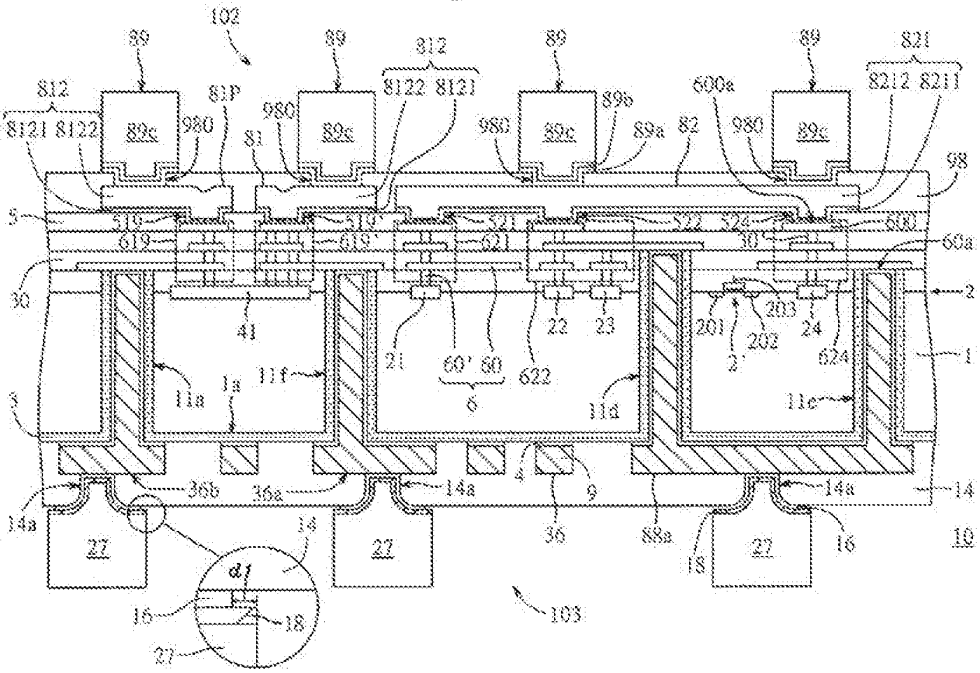


Fig. 30L

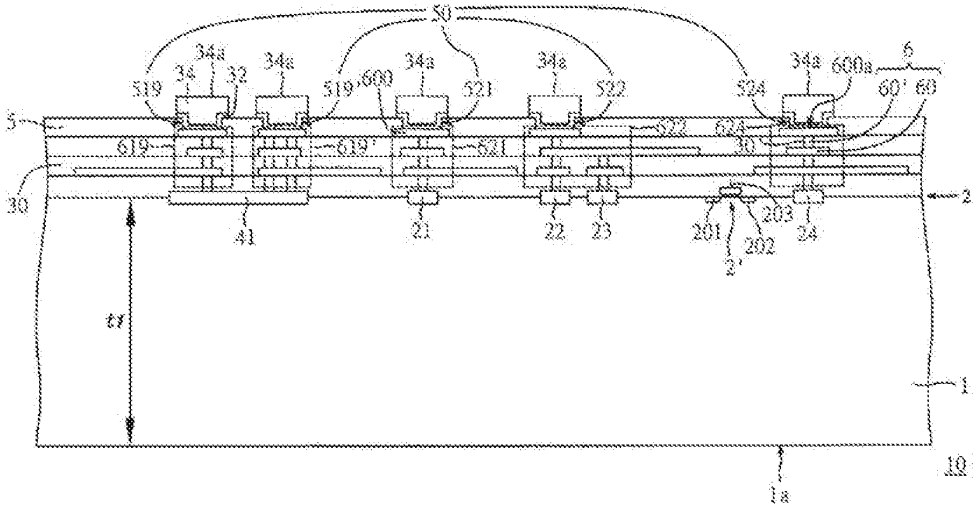


Fig. 30M

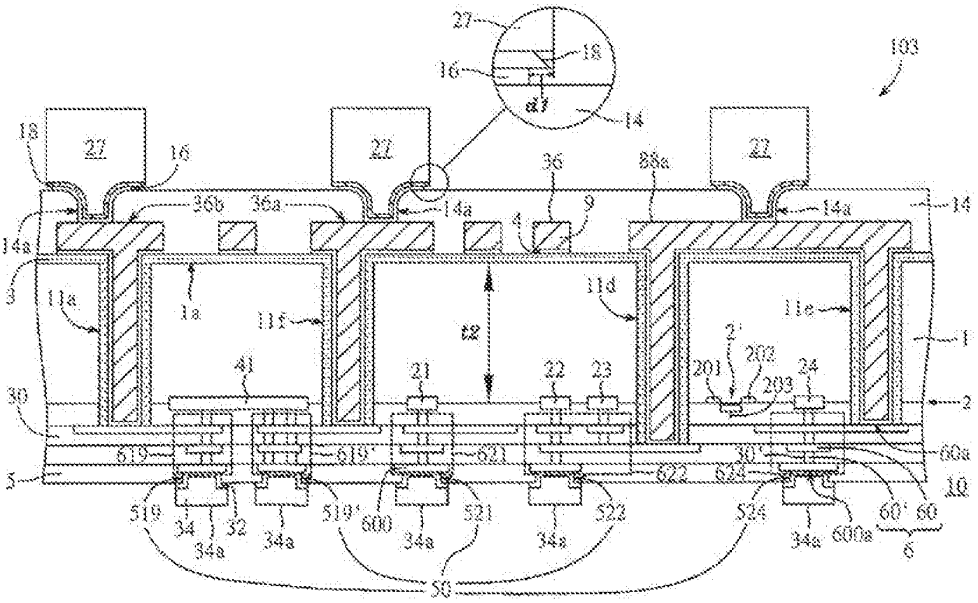


Fig. 30N

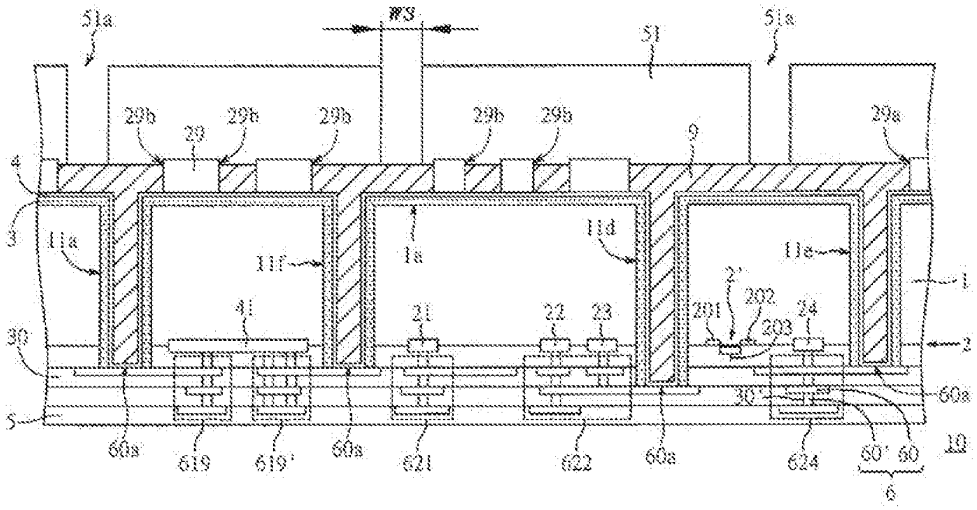


Fig. 31A

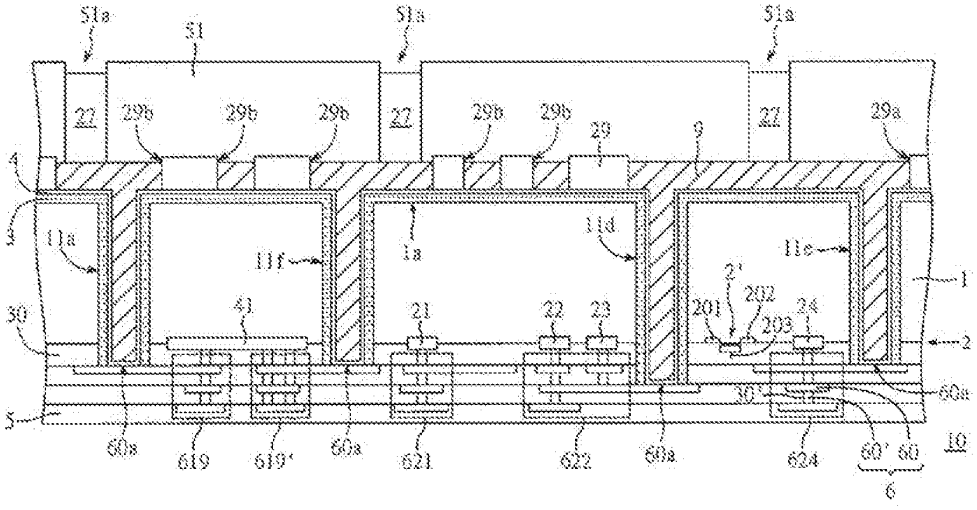


Fig. 31B

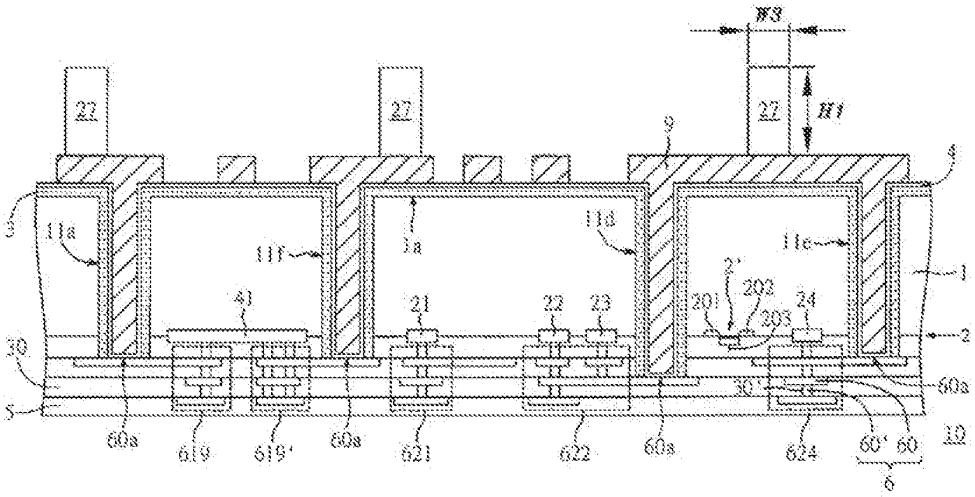


Fig. 31C

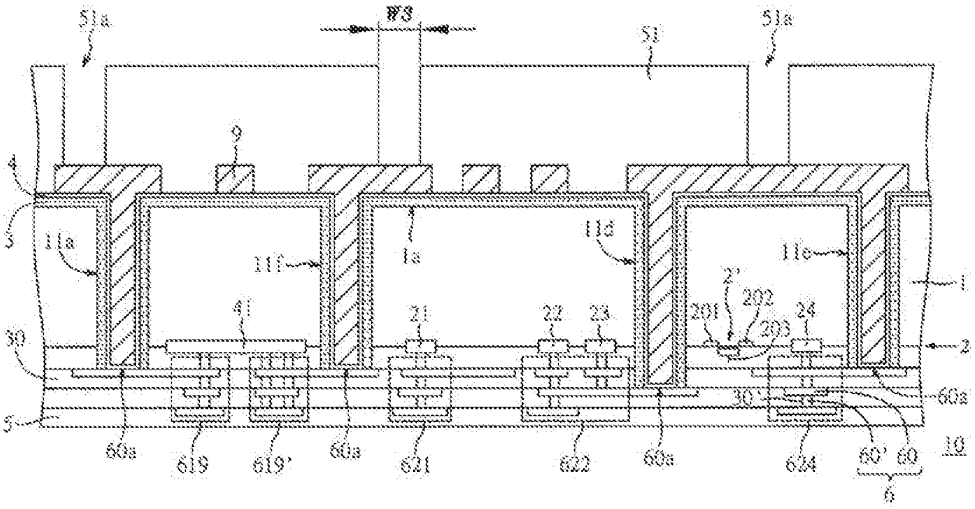


Fig. 31D

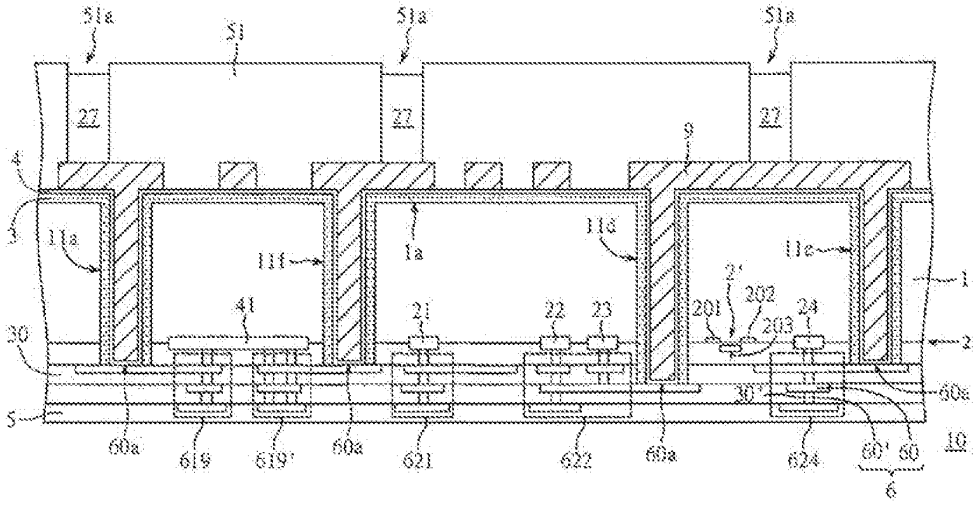


Fig. 31E

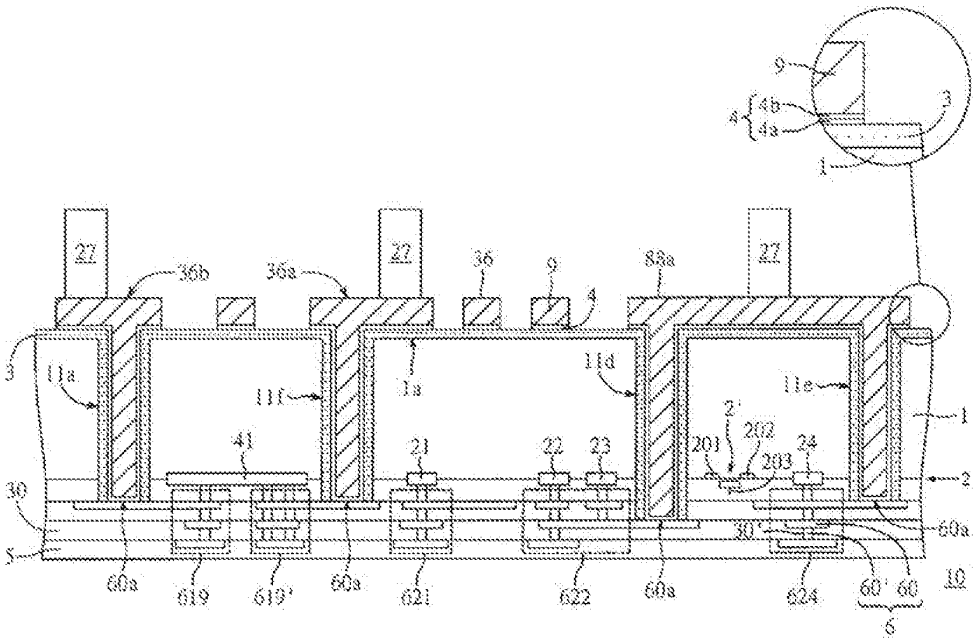


Fig. 31F

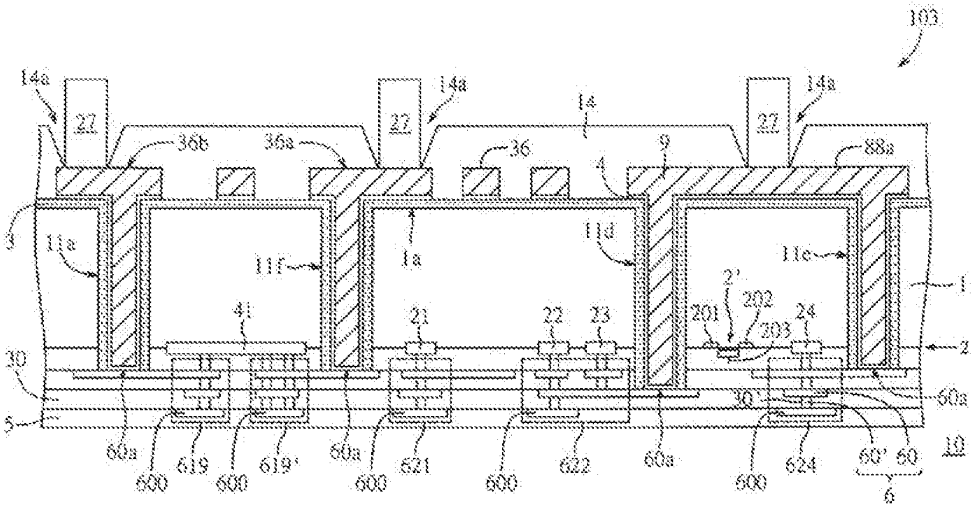


Fig. 31G

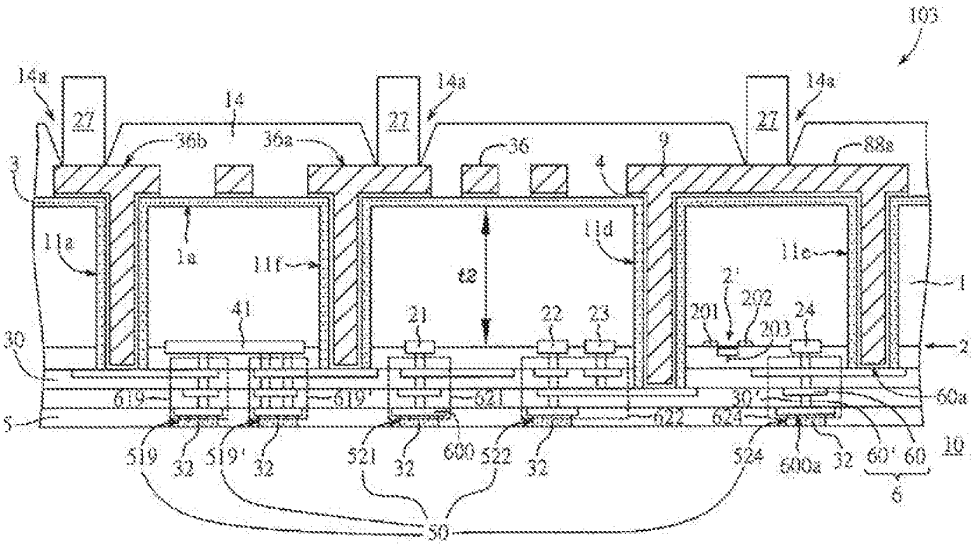


Fig. 31H

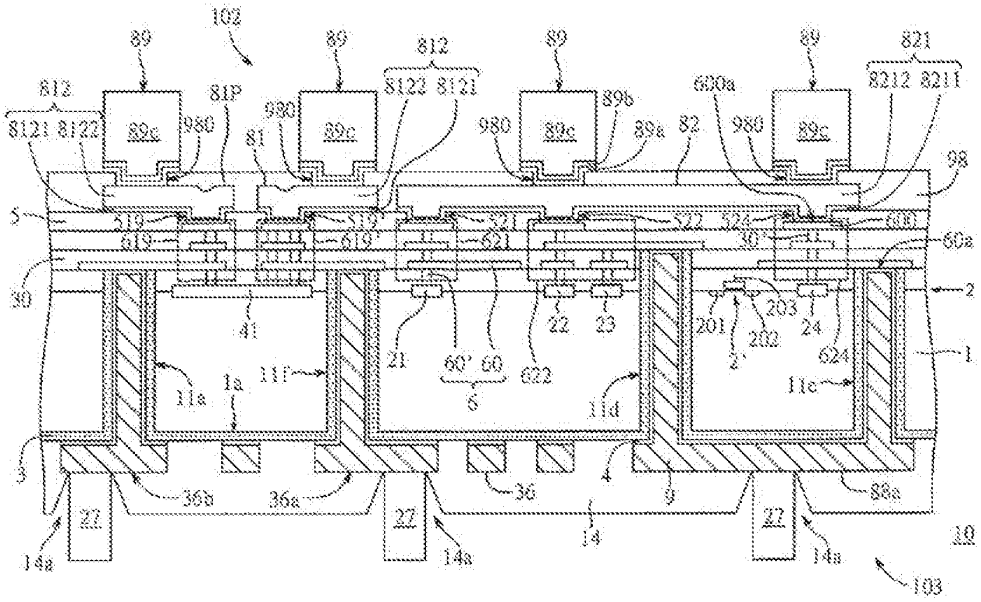


Fig. 31I

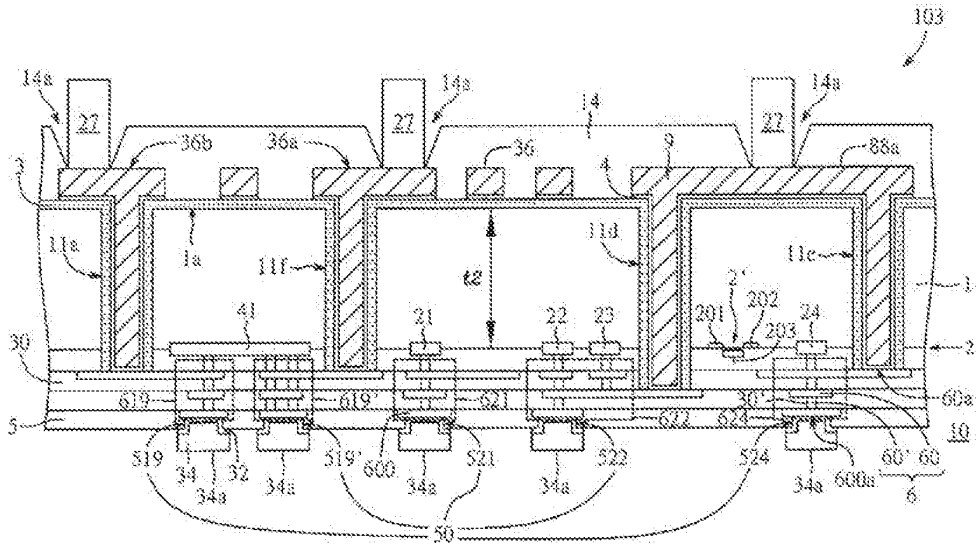


Fig. 31J

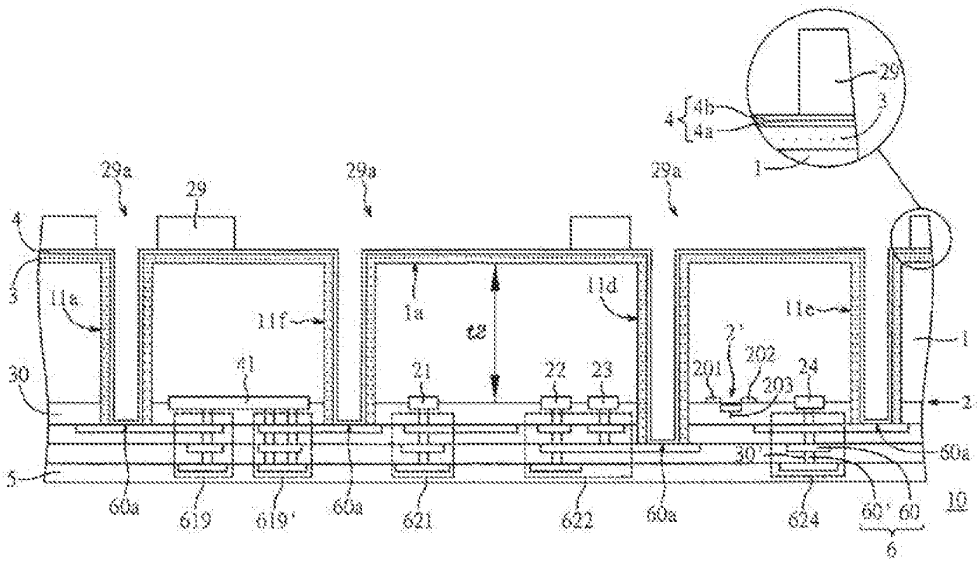


Fig. 32A

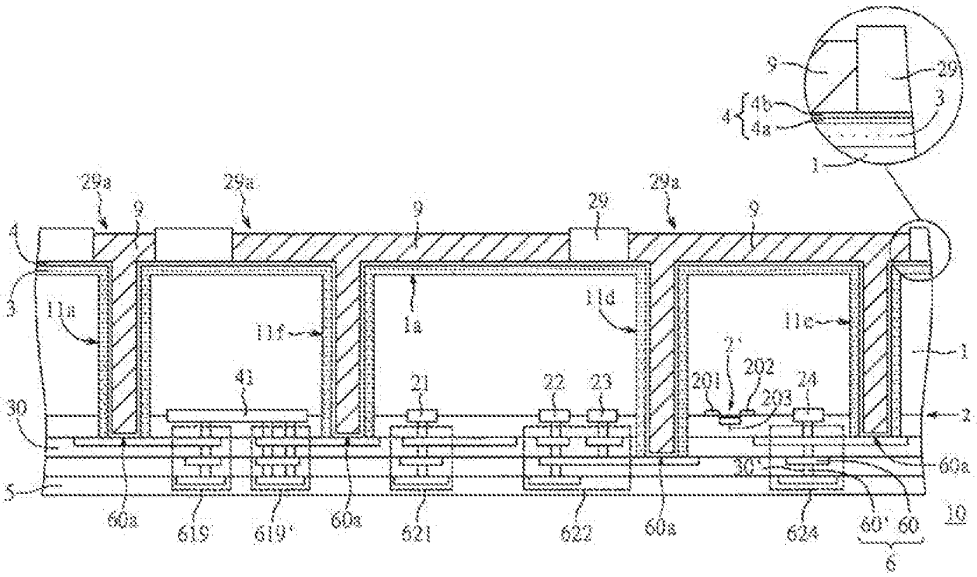


Fig. 32B

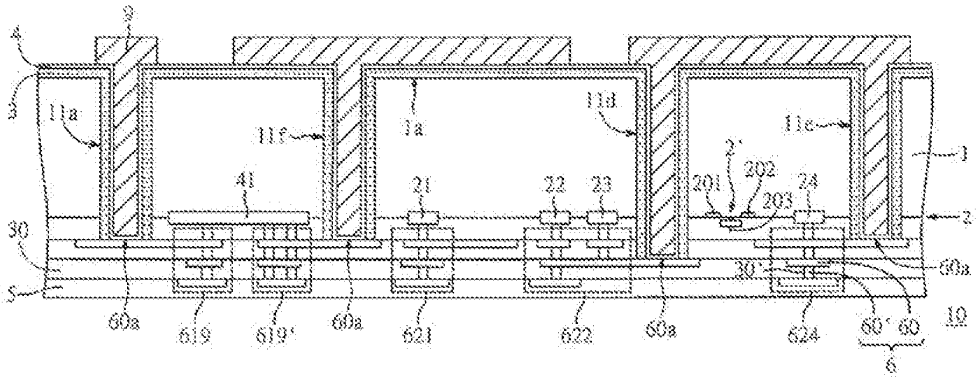


Fig. 32C

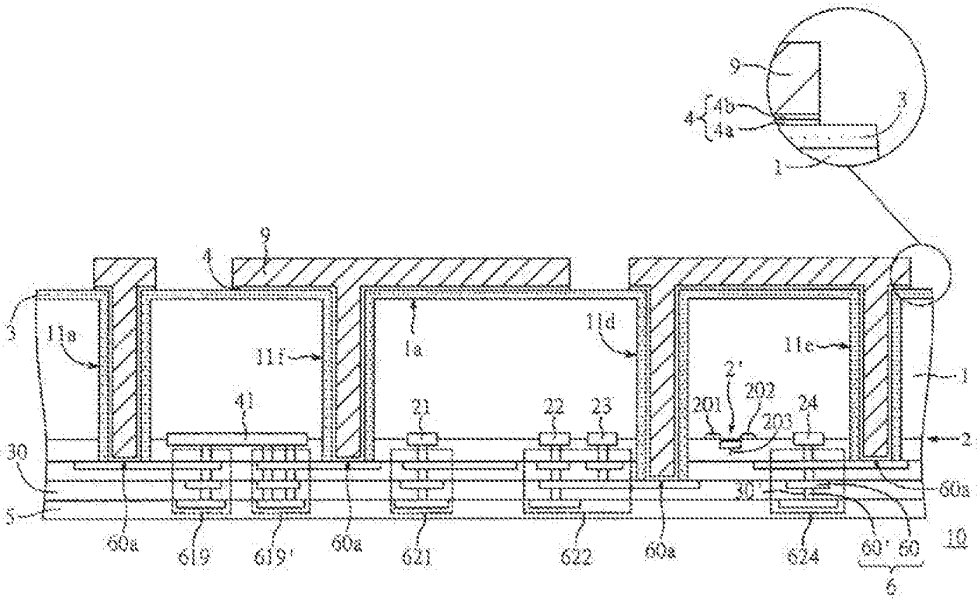


Fig. 32D

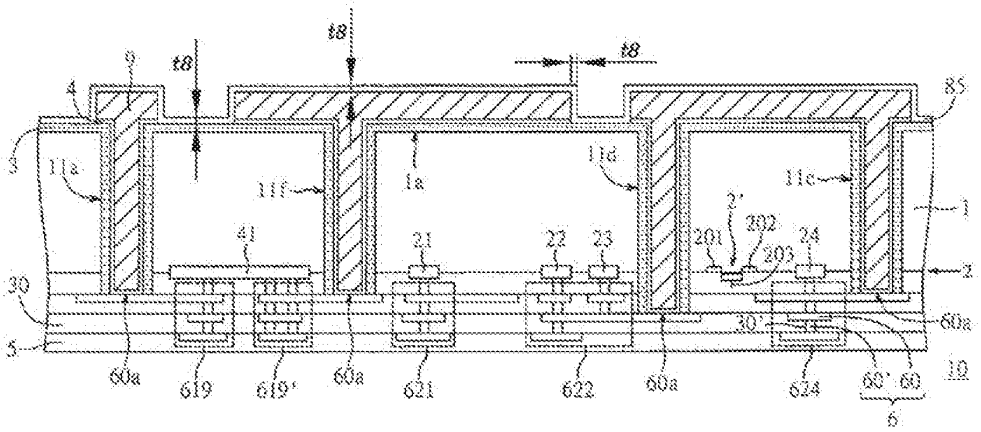


Fig. 32E

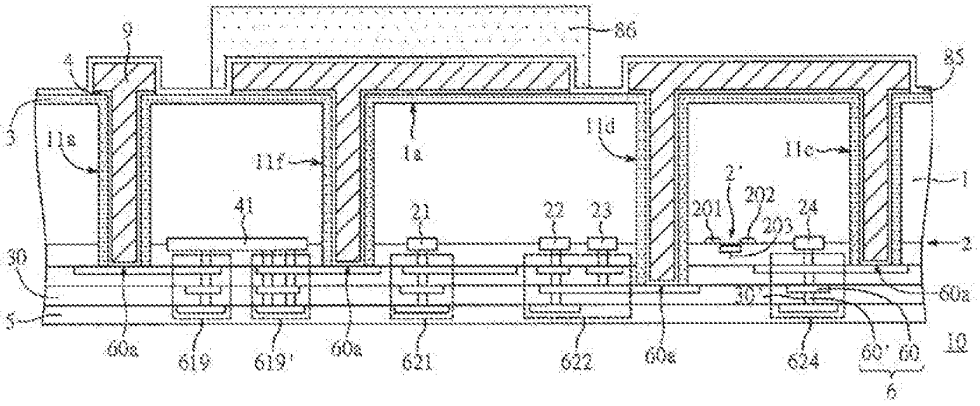


Fig. 32F

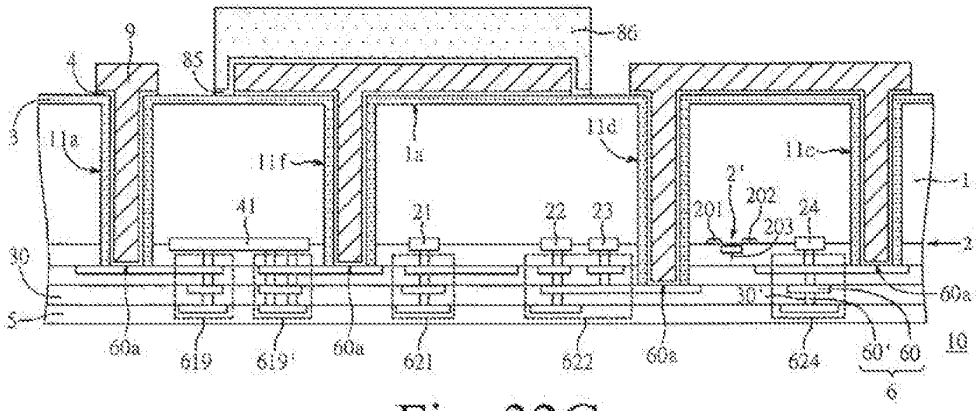


Fig. 32G

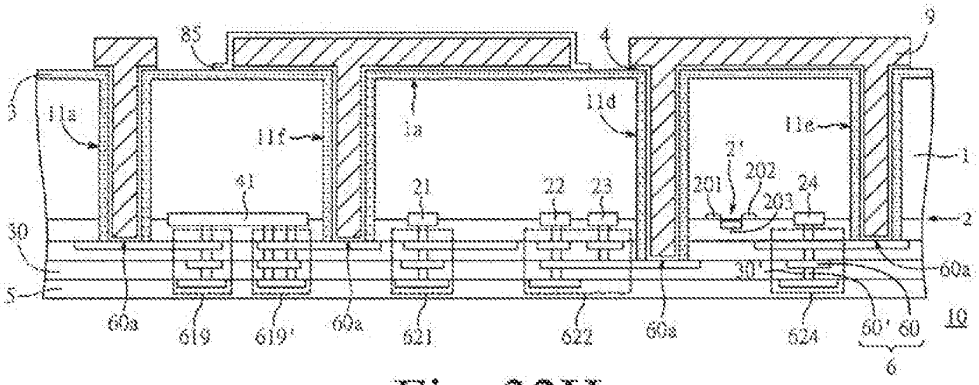


Fig. 32H

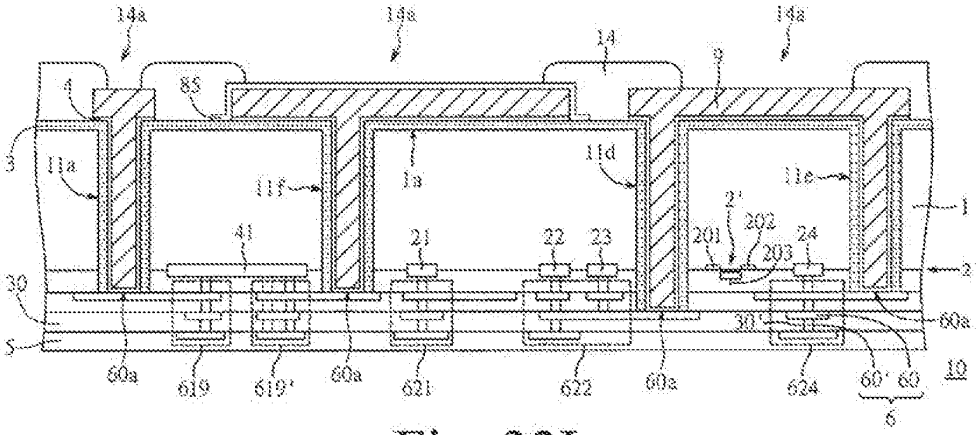


Fig. 32I

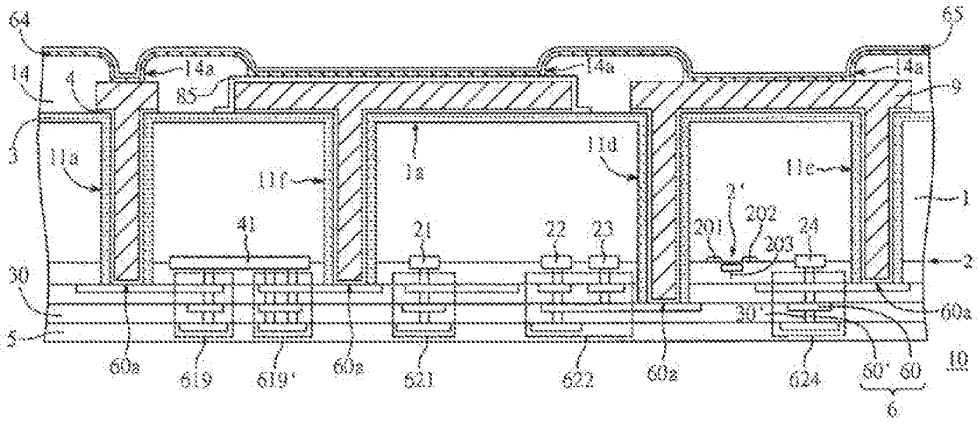


Fig. 32J

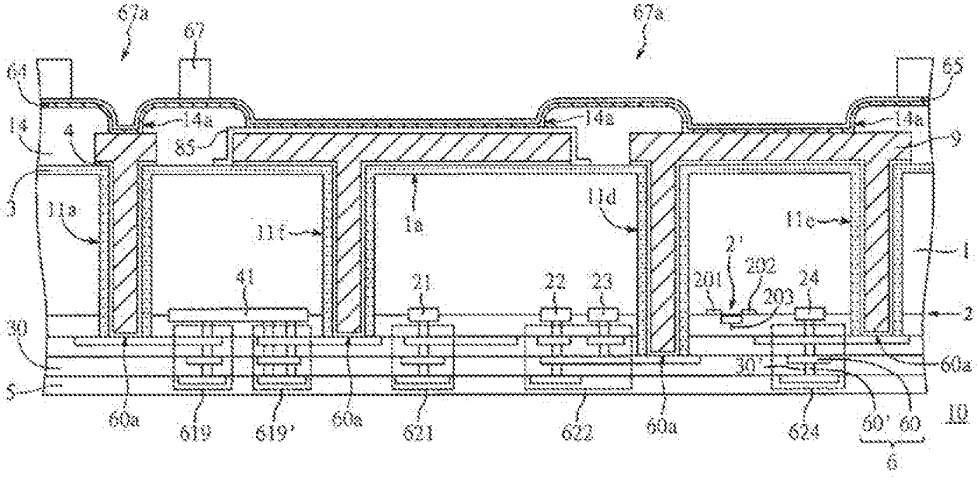


Fig. 32K

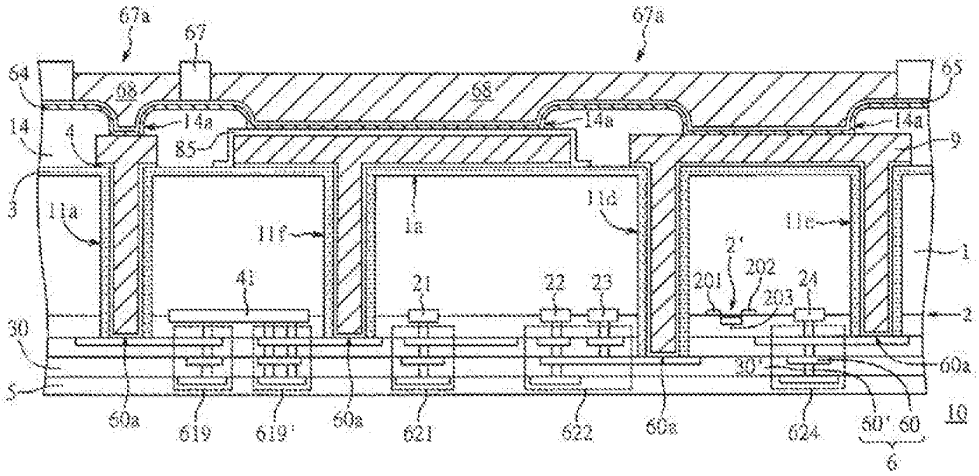


Fig. 32L

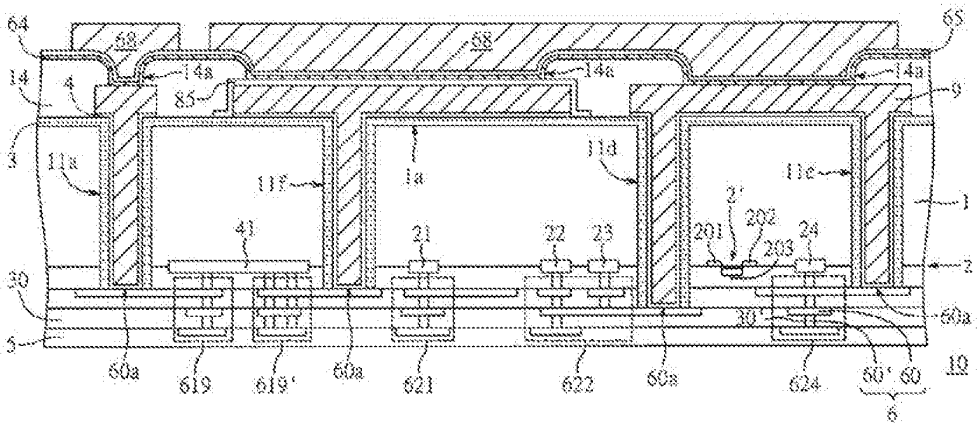


Fig. 32M

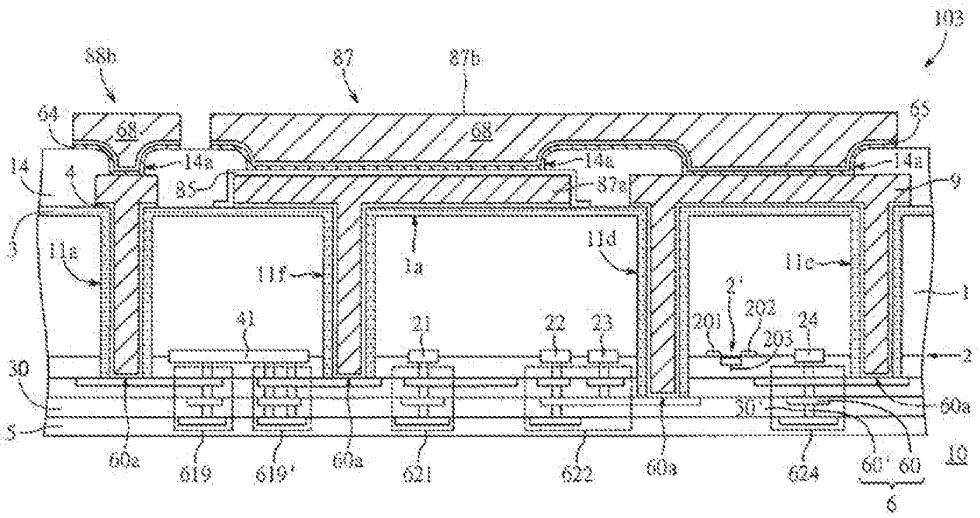


Fig. 32N

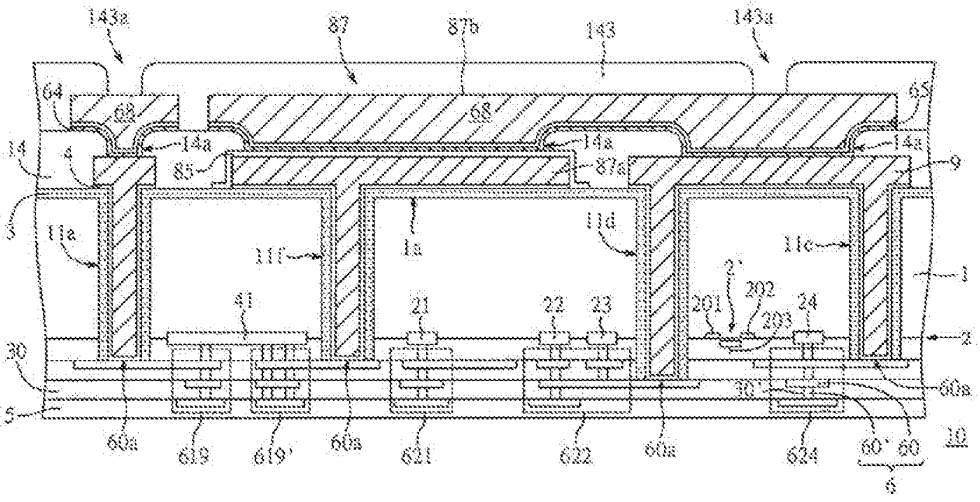


Fig. 32O

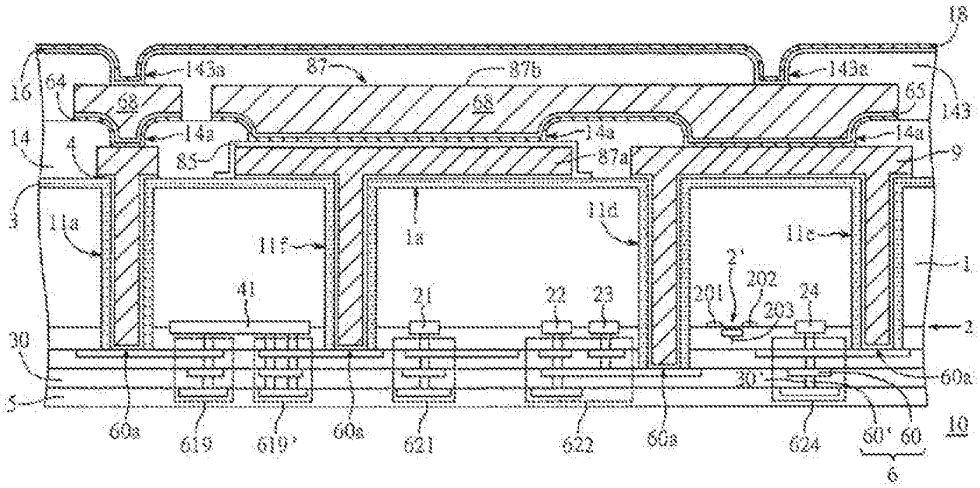


Fig. 32P

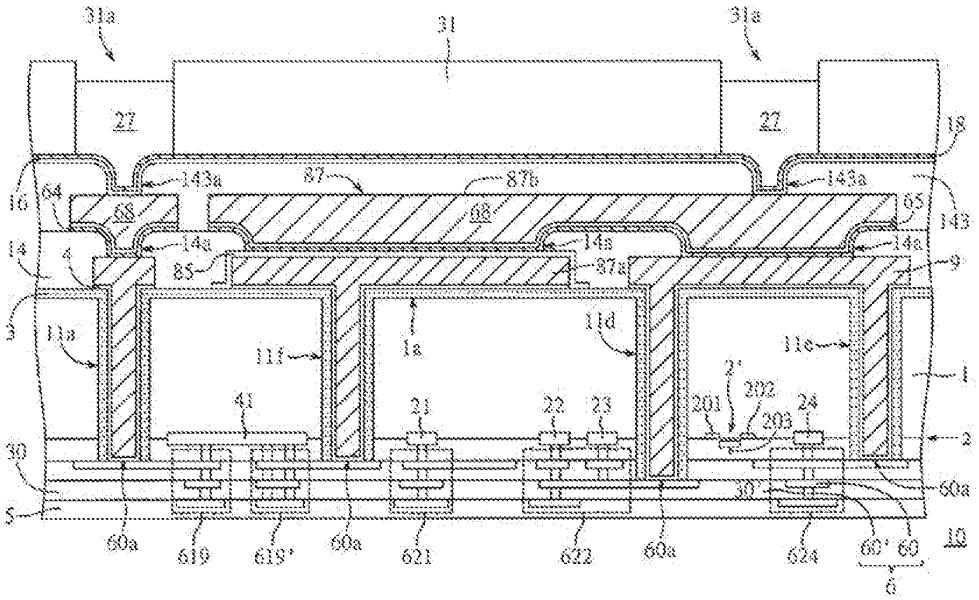


Fig. 32Q

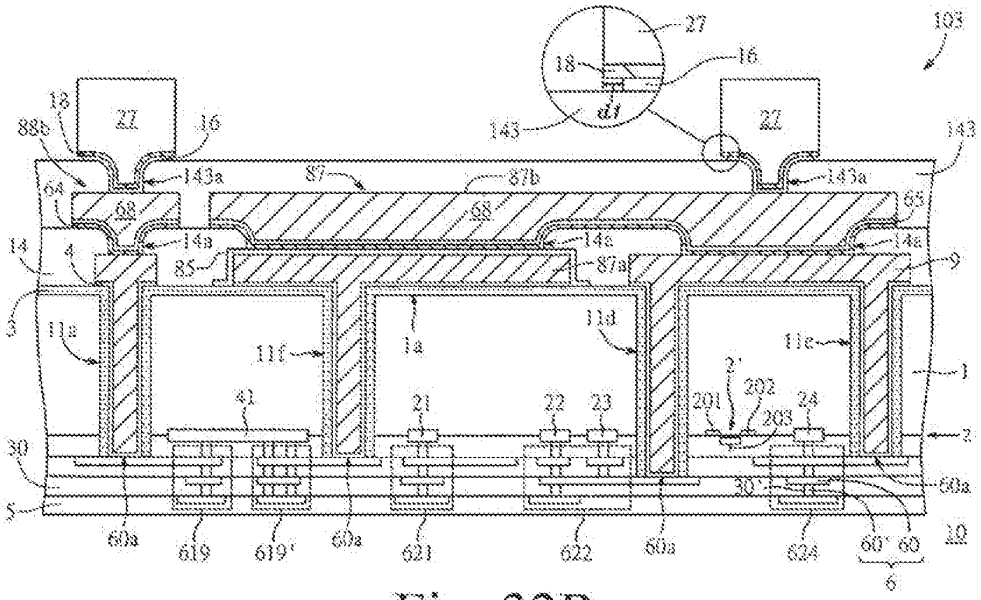


Fig. 32R

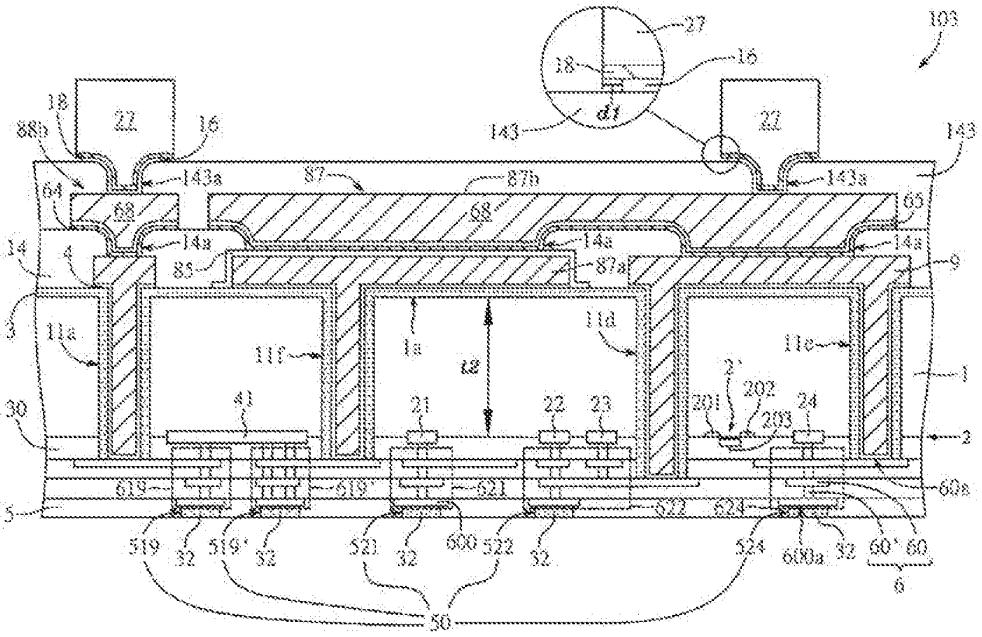


Fig. 32S

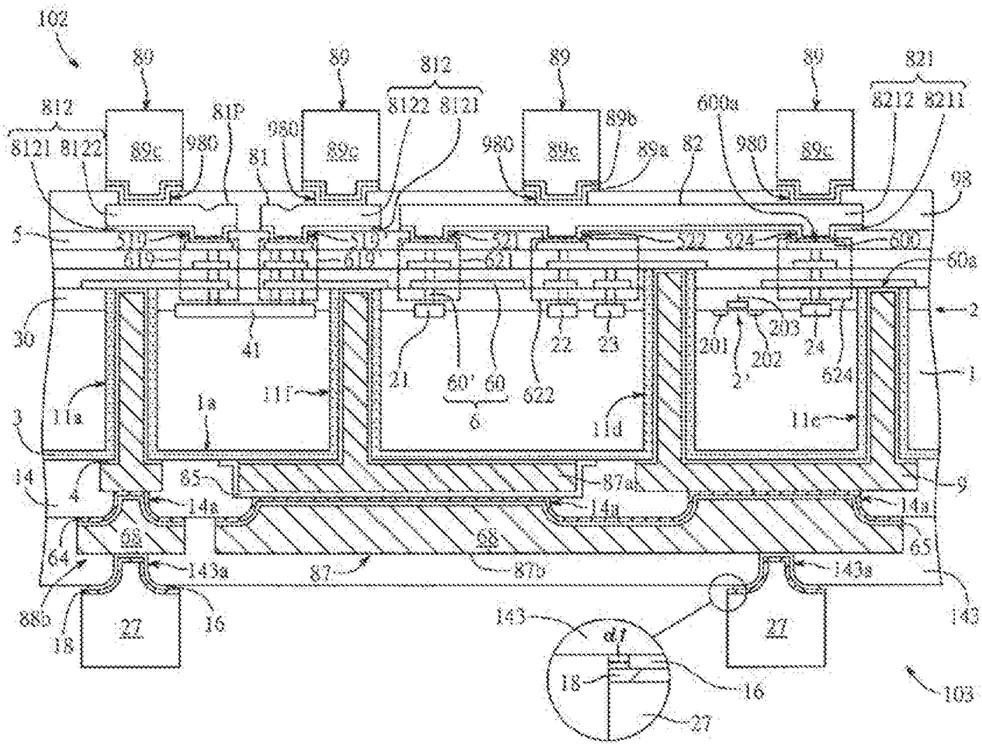
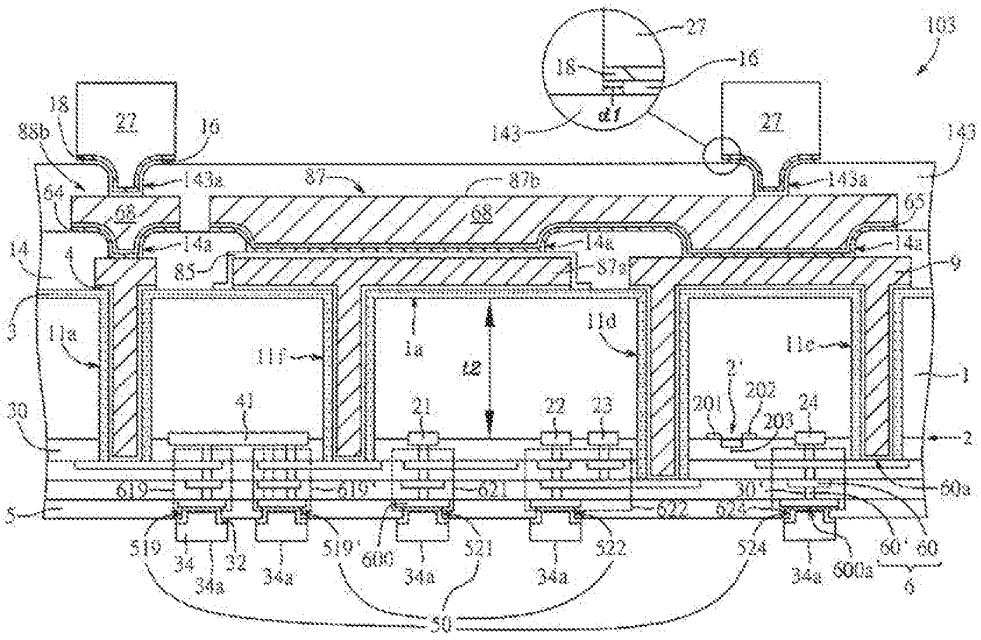


Fig. 32T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14a
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9
3
11a
11f
1a
t2
11d
11e
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610'
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623
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6
50

Fig. 32U

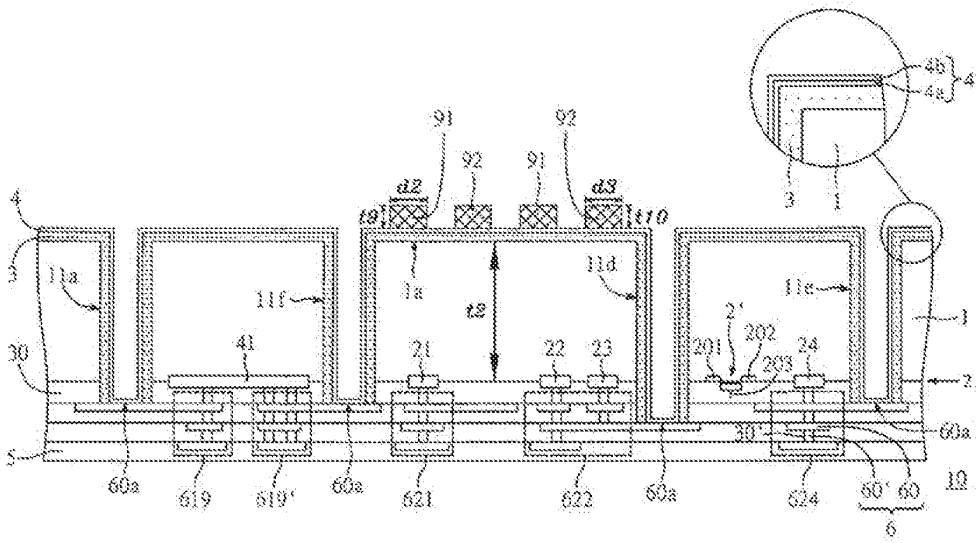

Fig. 33A

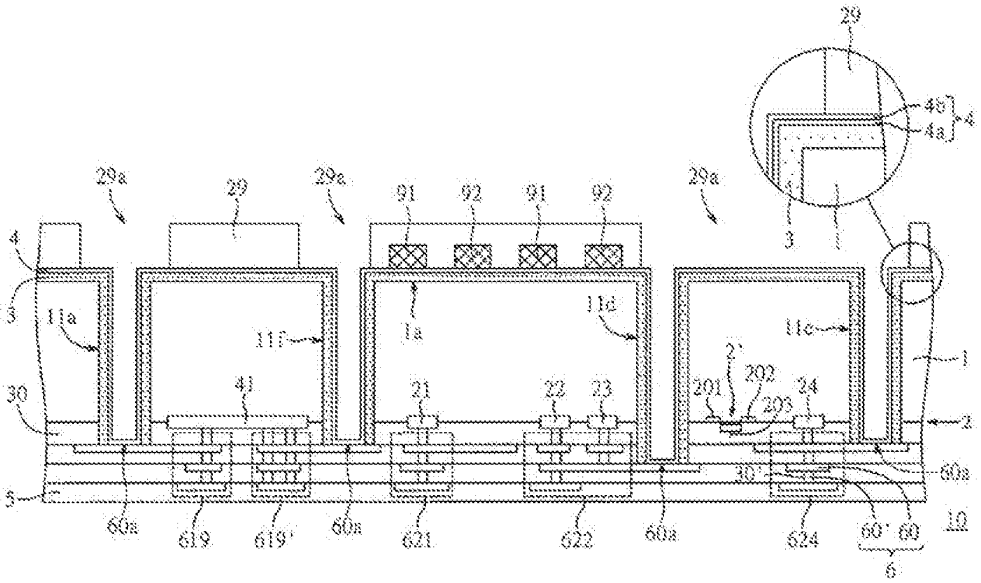

Fig. 33B

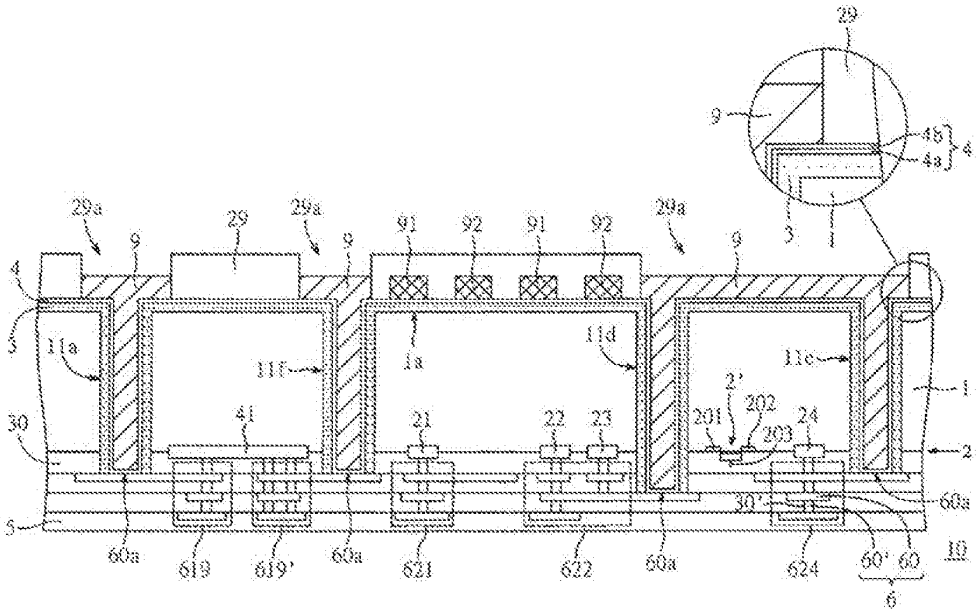

Fig. 33C

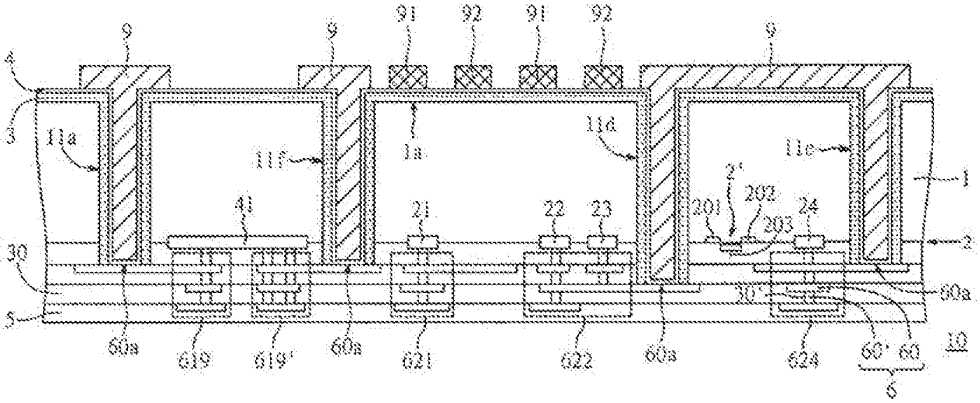

Fig. 33D

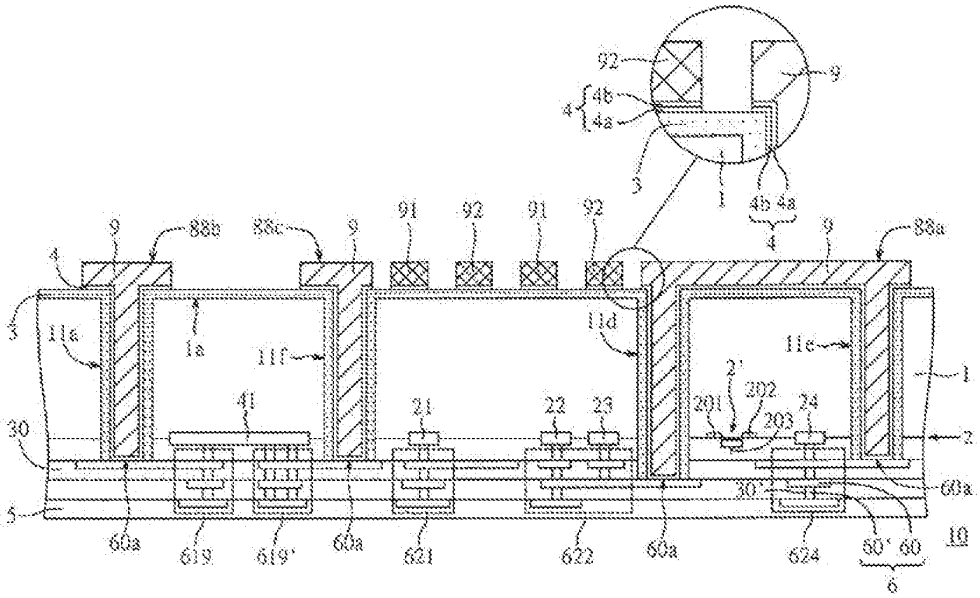

Fig. 33E

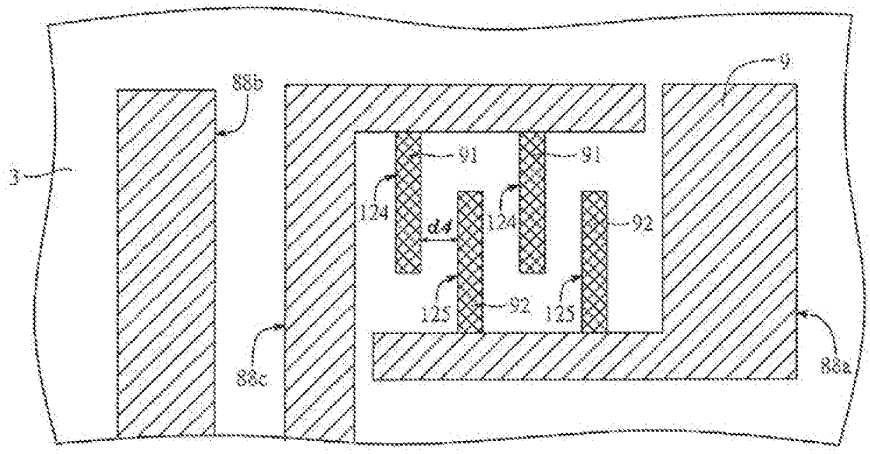

Fig. 33F

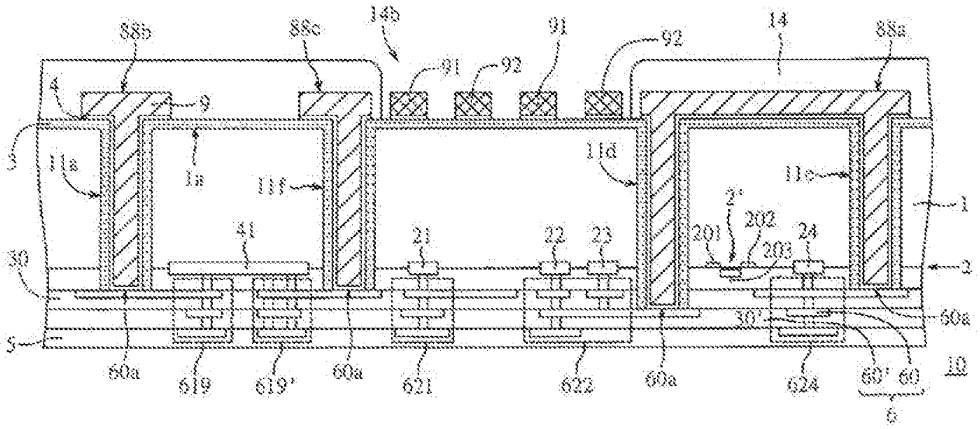

Fig. 33G

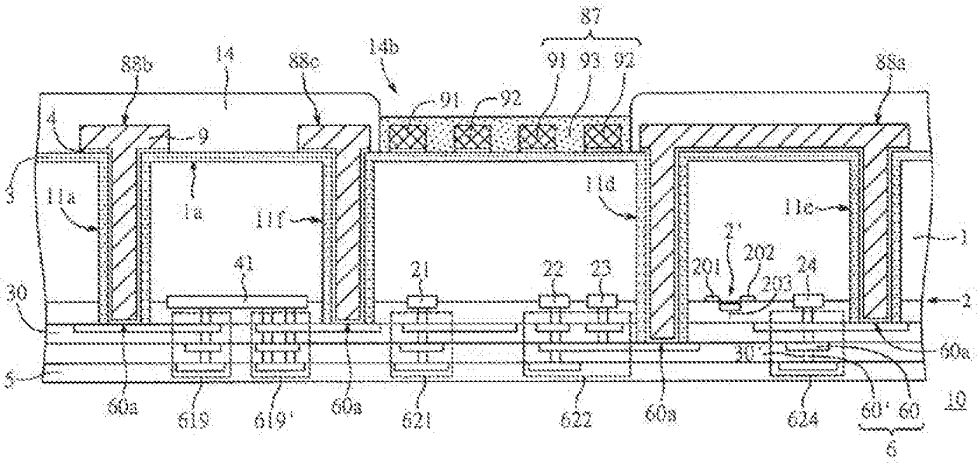

Fig. 33H

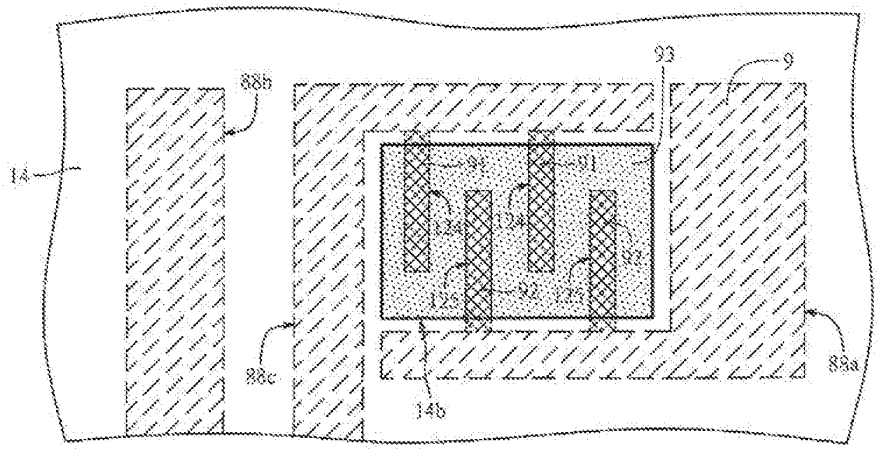

Fig. 33I

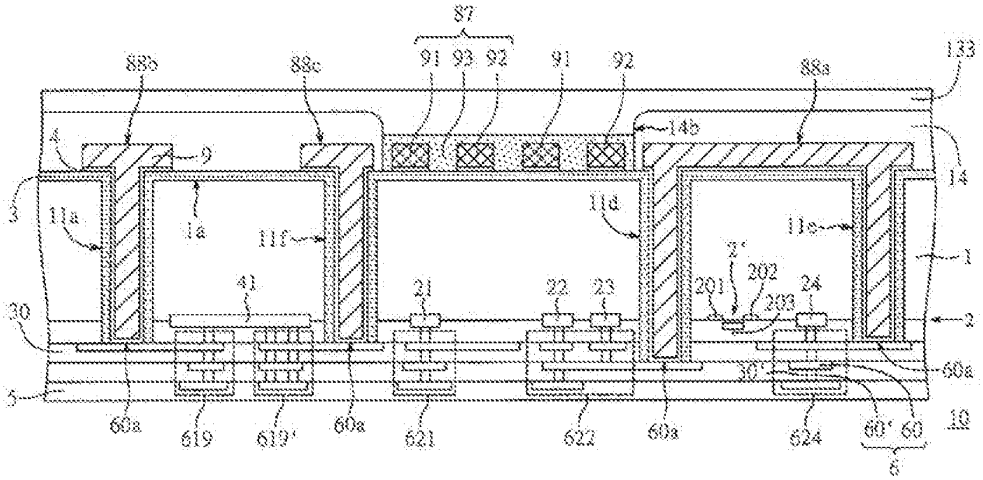

Fig. 33J

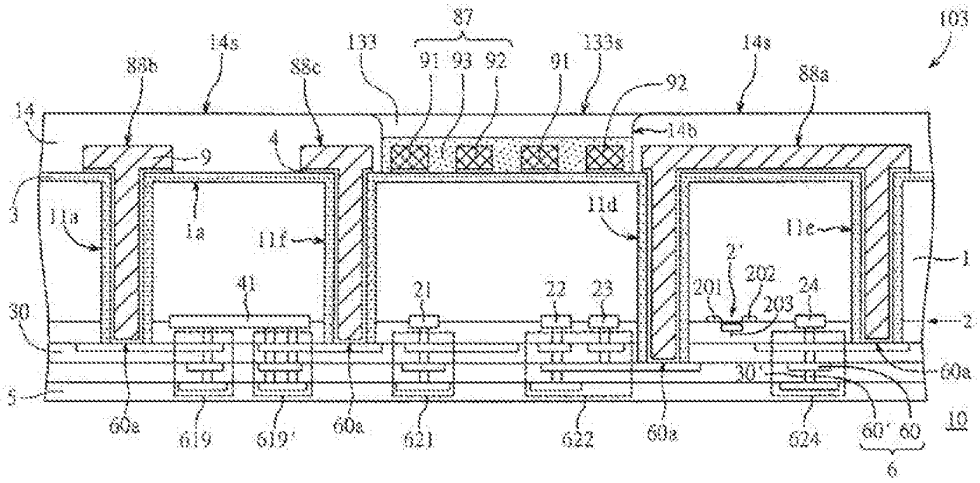

Fig. 33K

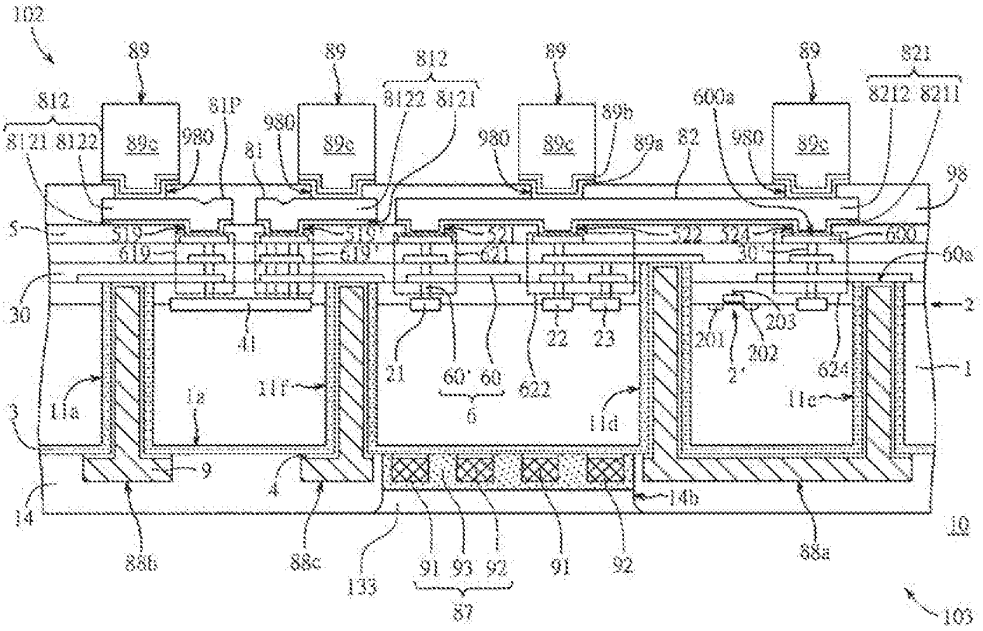

Fig. 33L

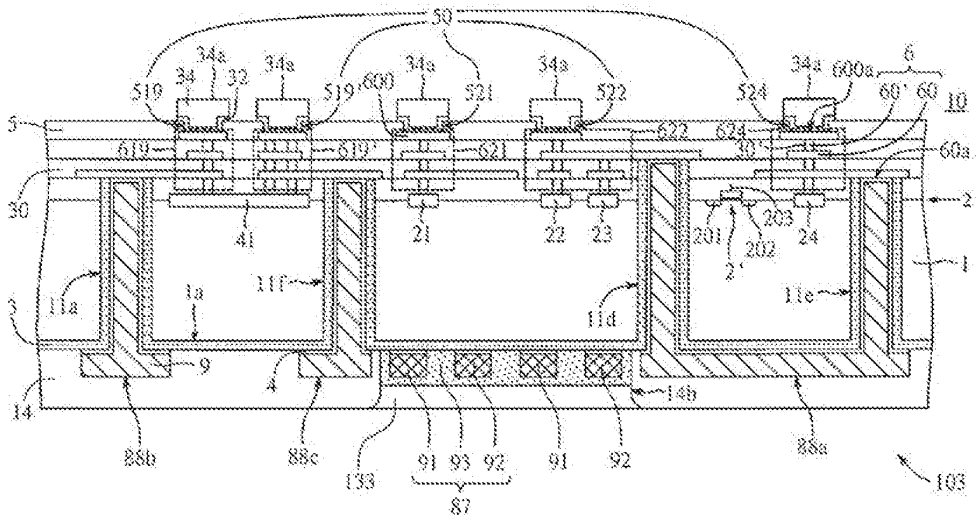

Fig. 33M

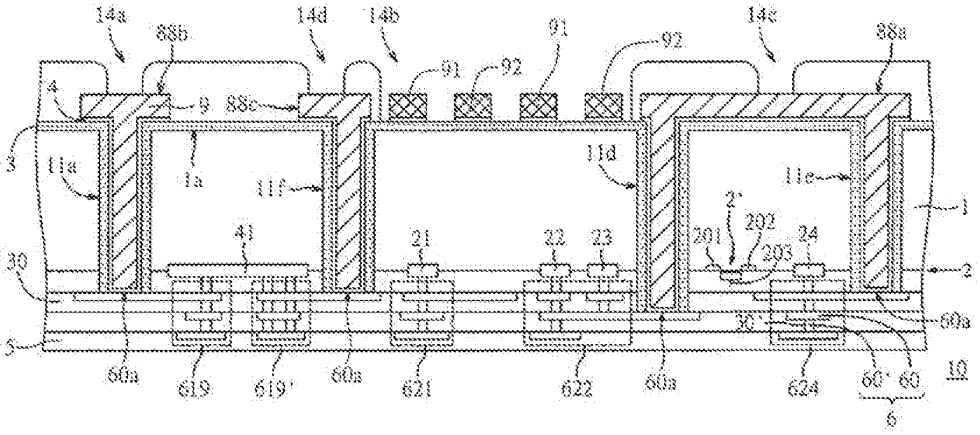

Fig. 33N

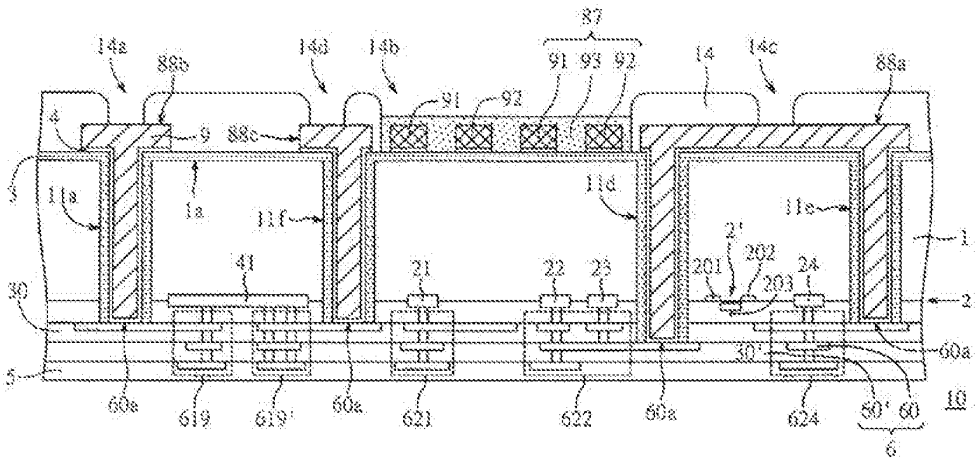

Fig. 33O

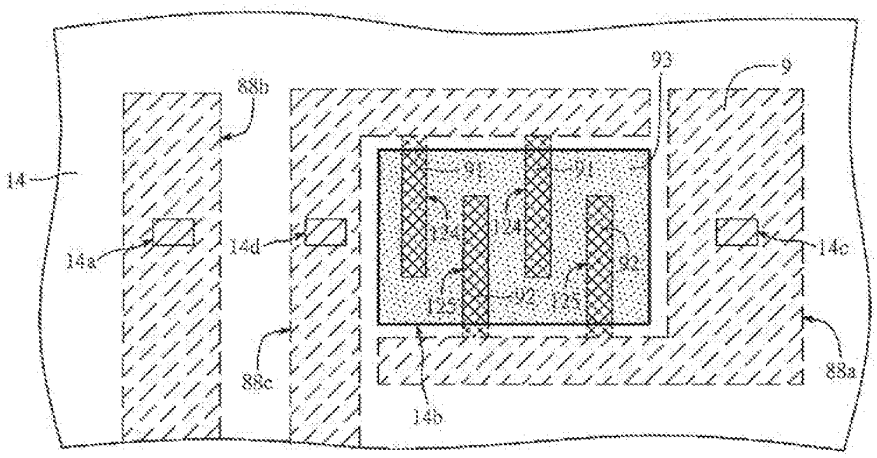

Fig. 33P

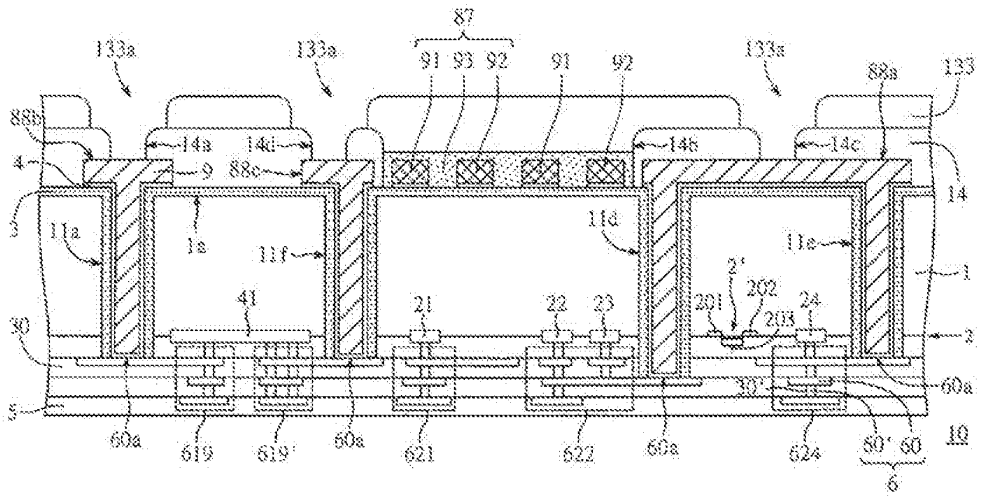

Fig. 33Q

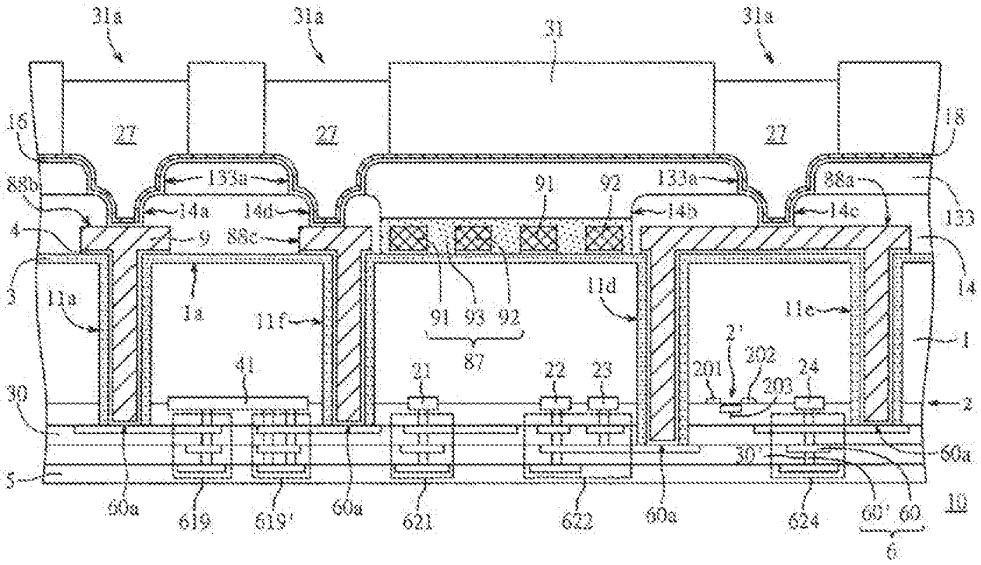

Fig. 33R

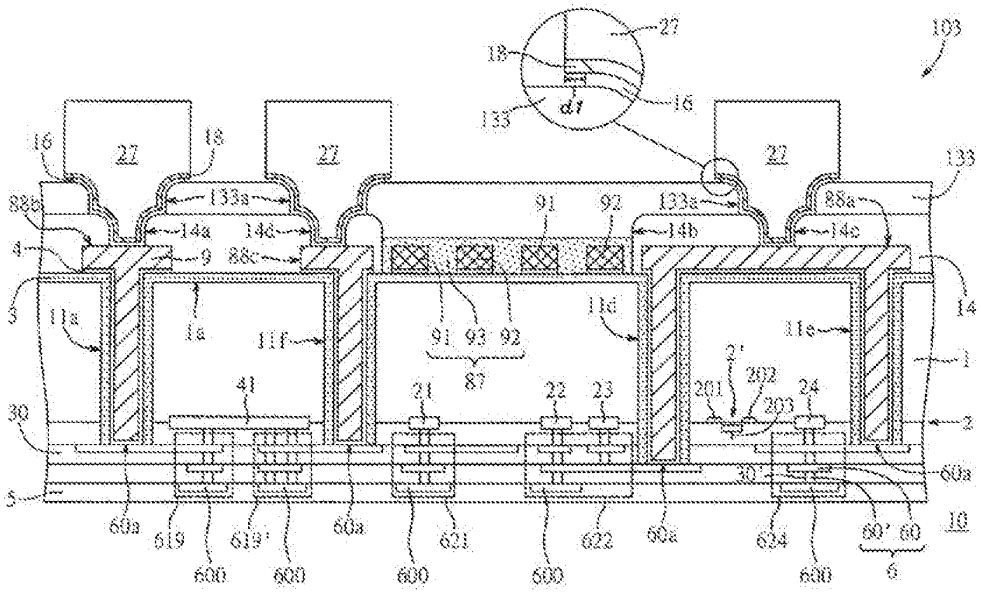

Fig. 33S

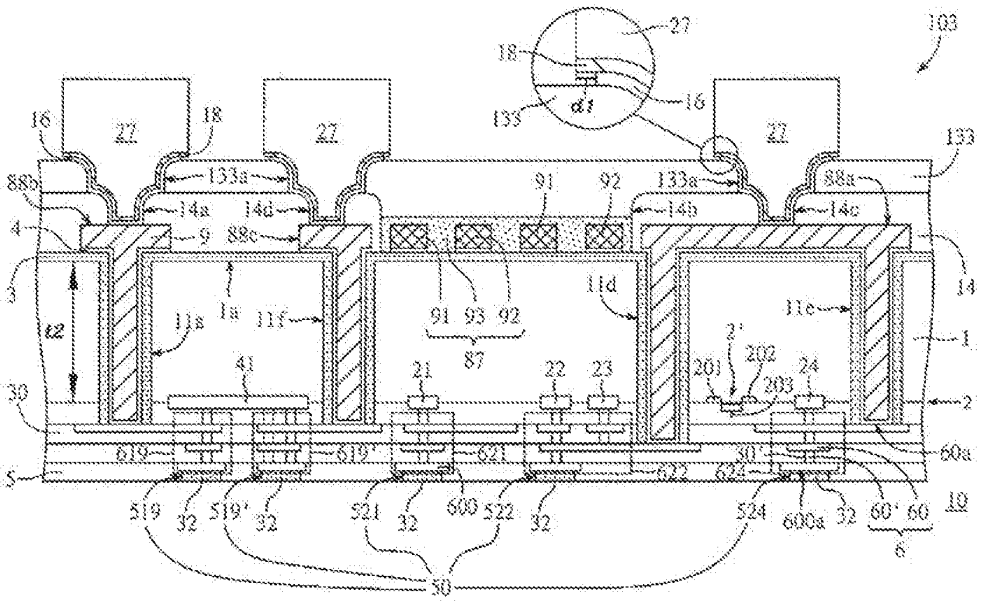

Fig. 33T

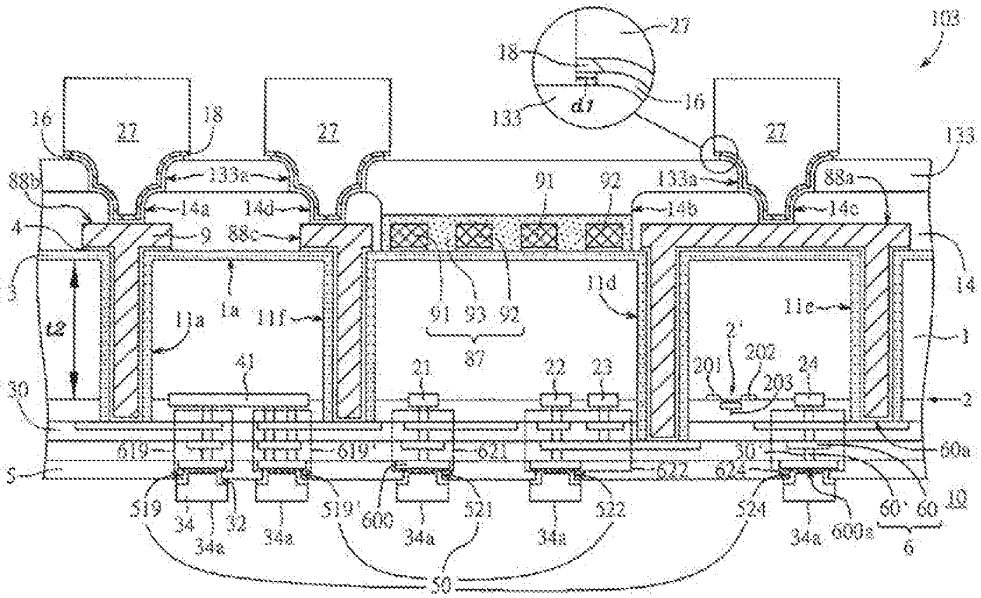

Fig. 33U

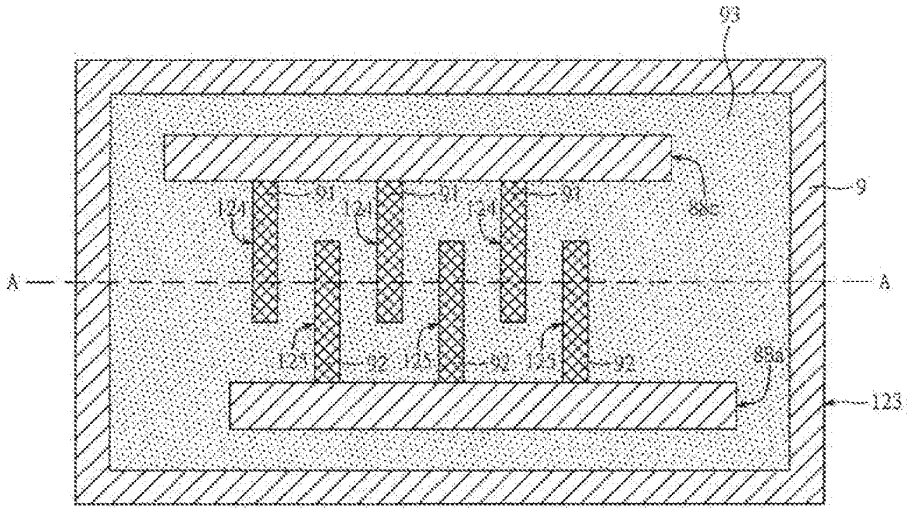

Fig. 33V

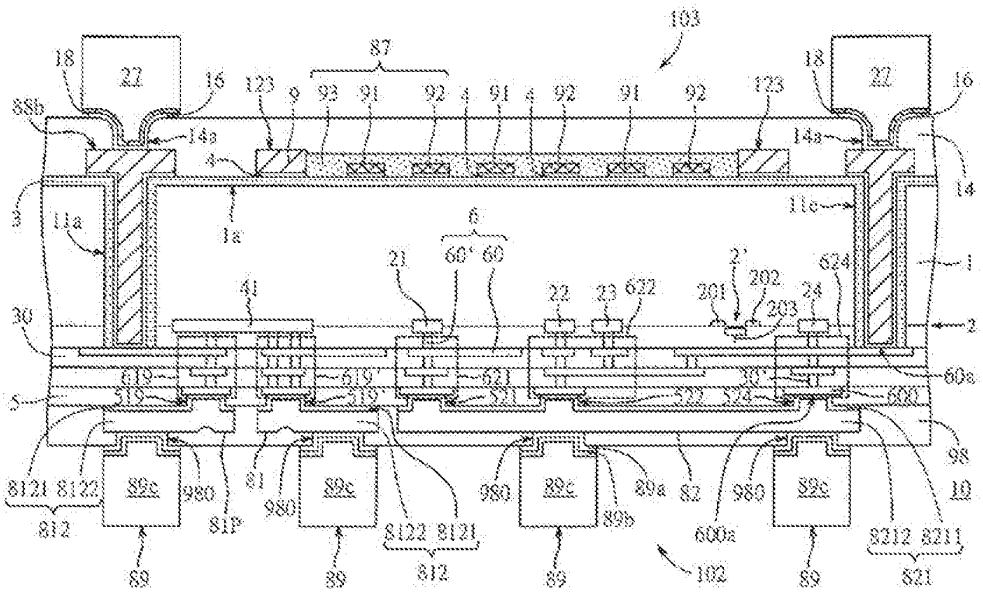

Fig. 33W

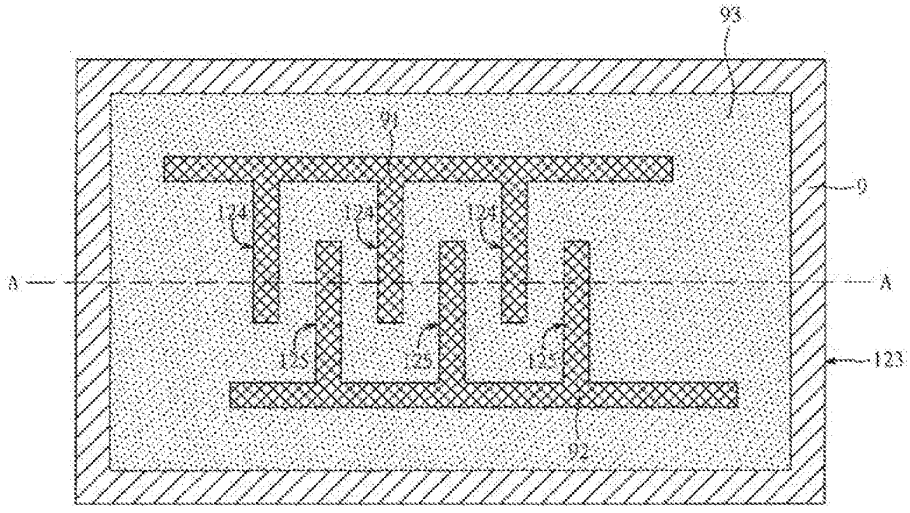

Fig. 33X

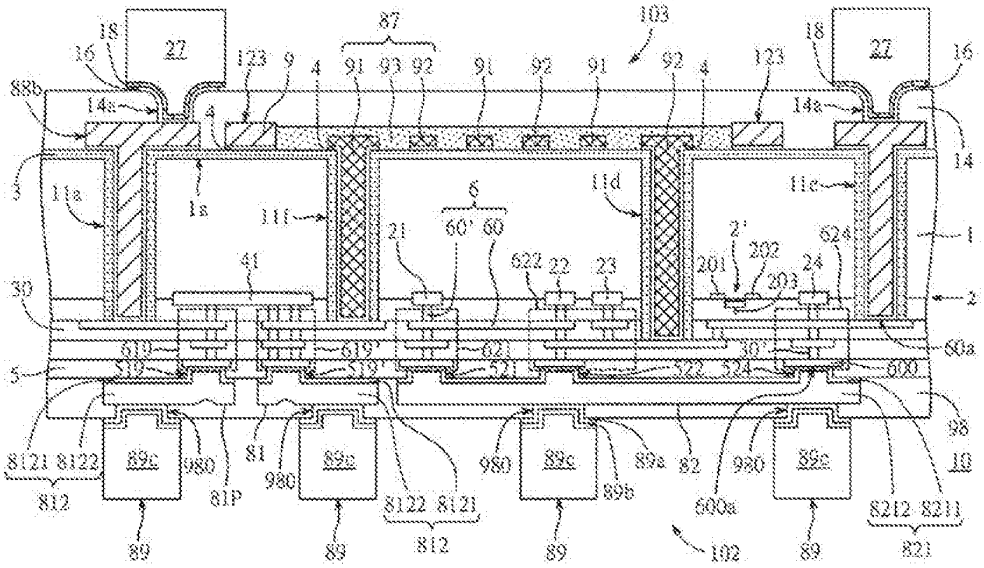

Fig. 33Y

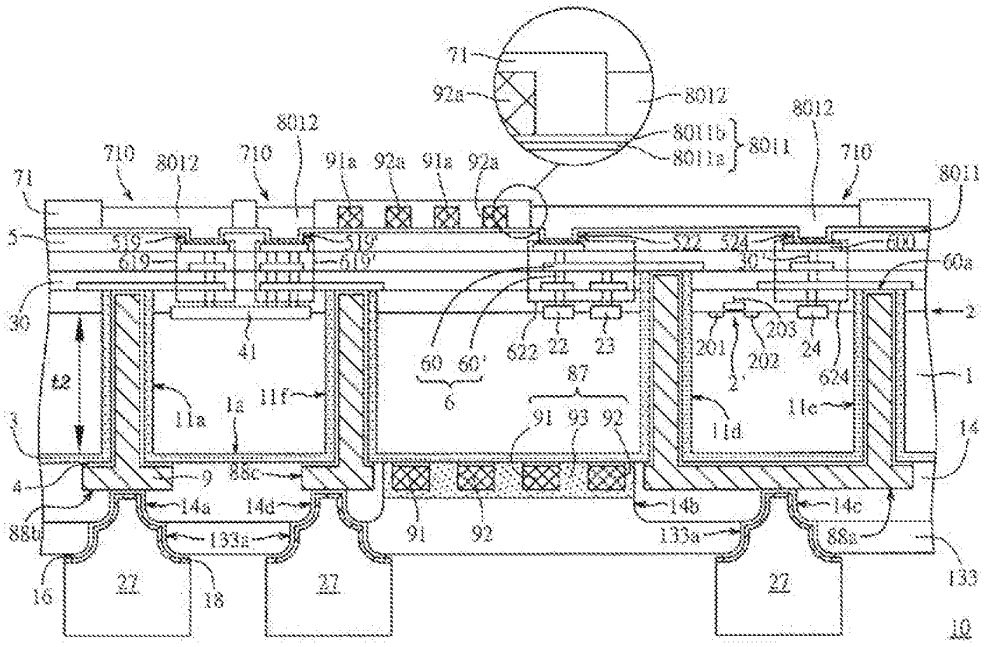

Fig. 34A

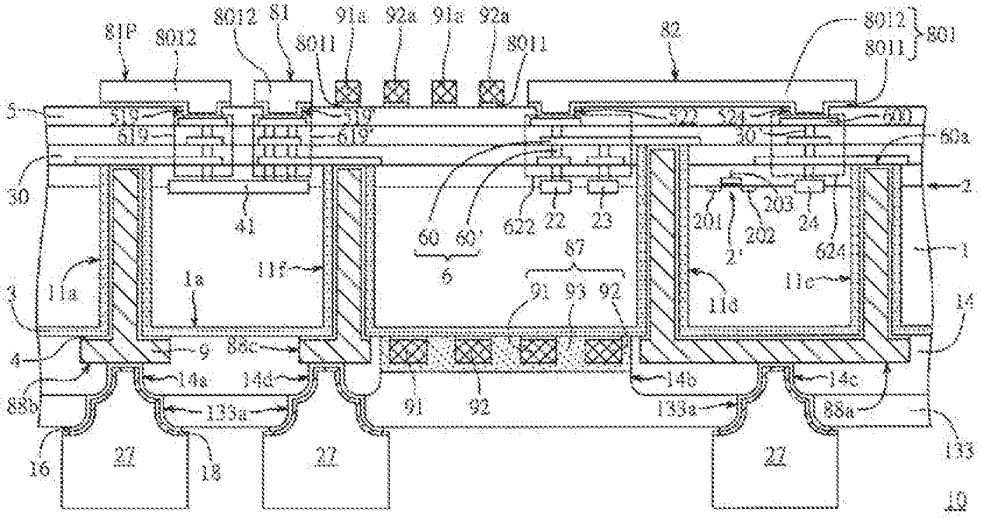

Fig. 34B

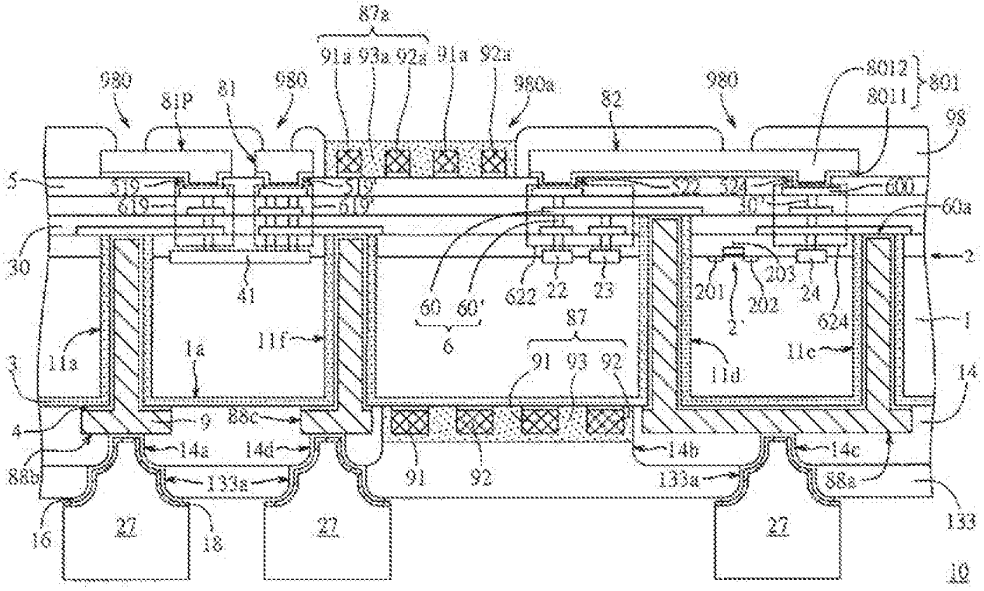

Fig. 34C

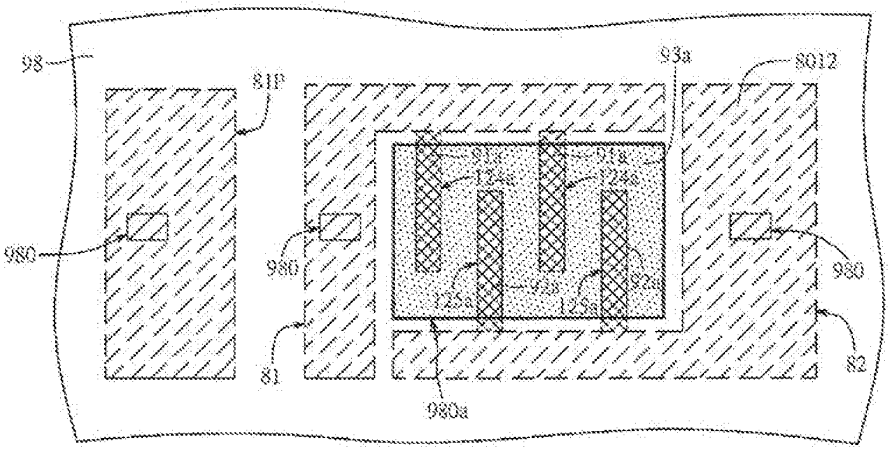

Fig. 34D

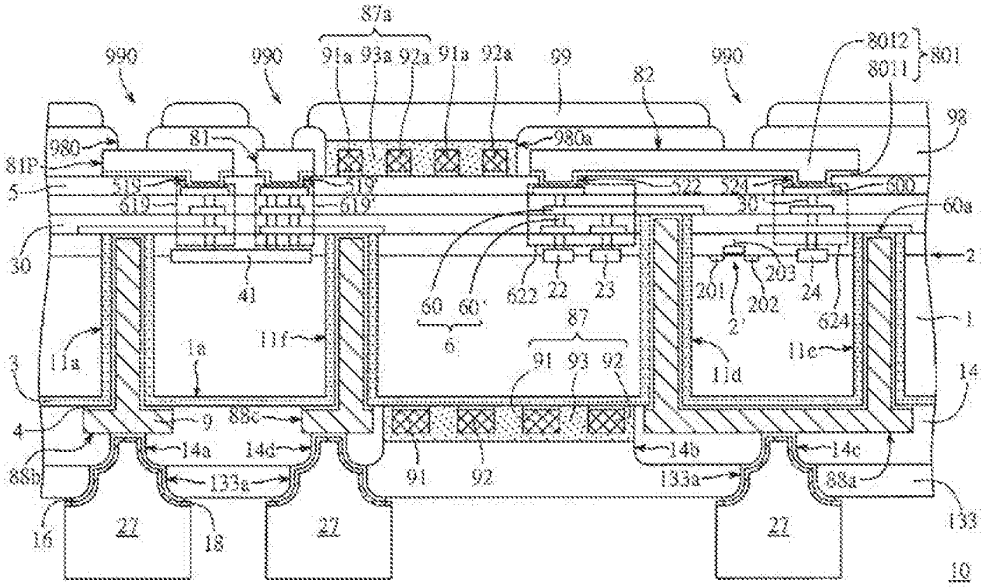

Fig. 34E

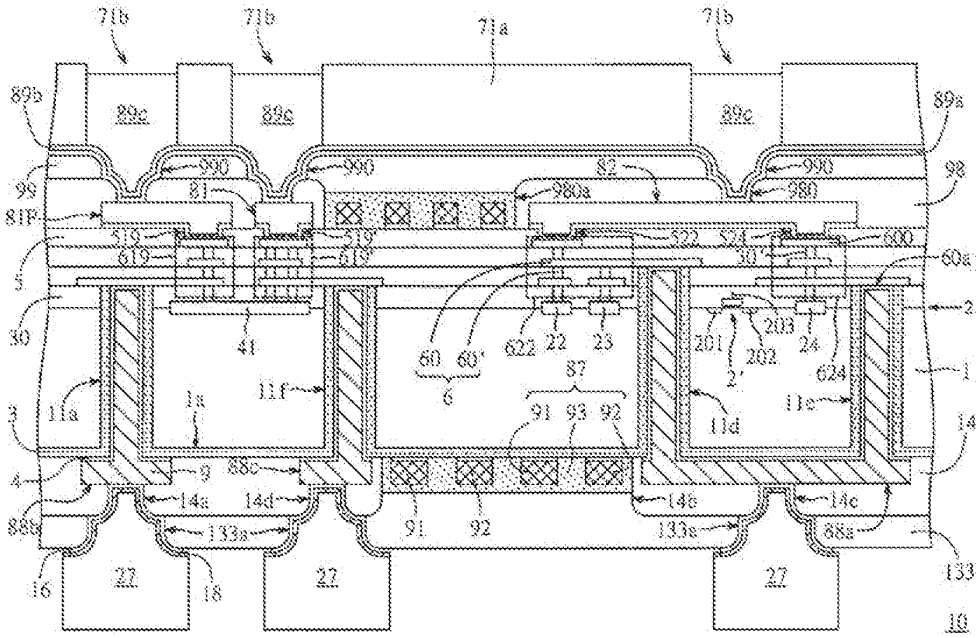

Fig. 34F

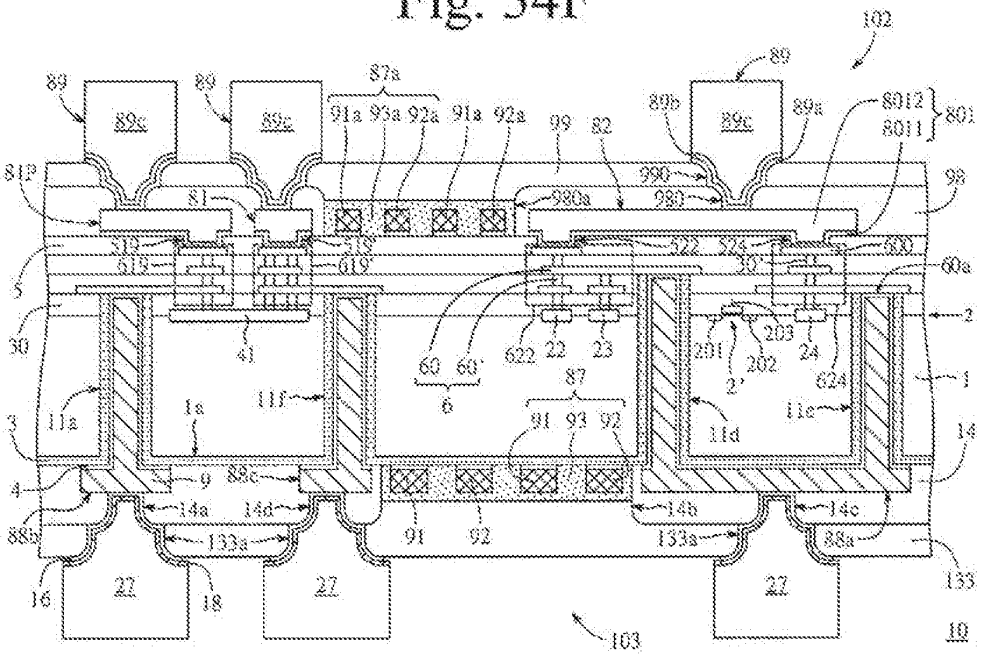

Fig. 34G

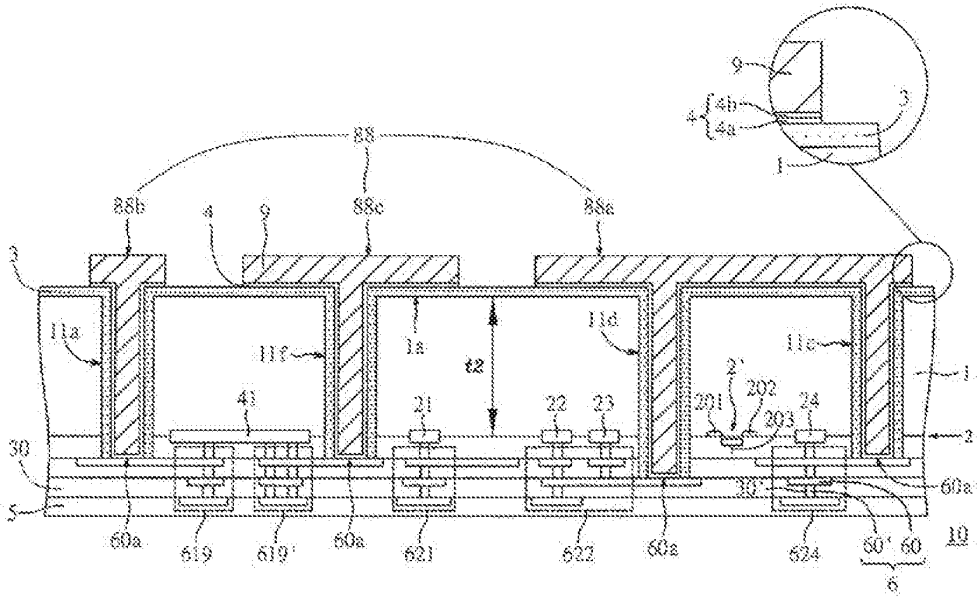

Fig. 35A

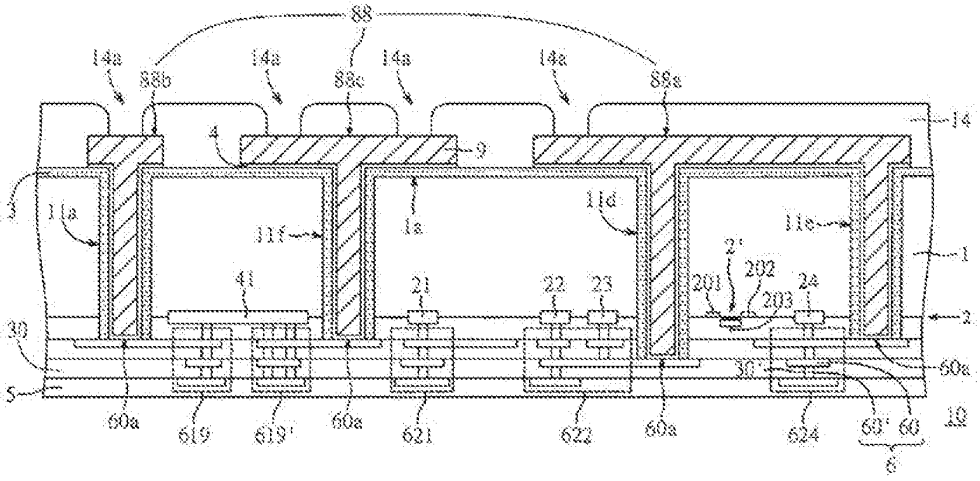

Fig. 35B

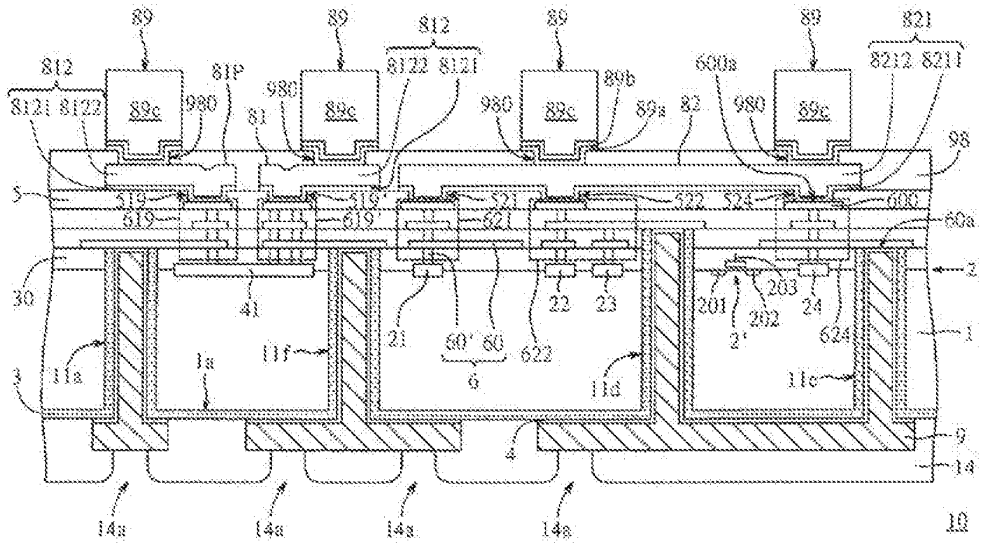

Fig. 35C

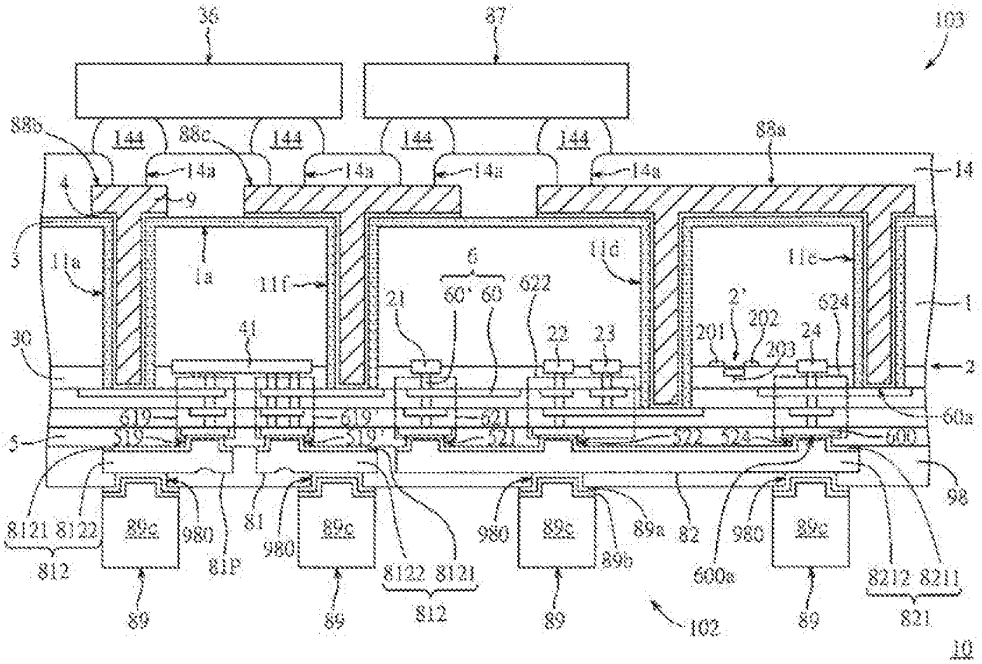

Fig. 35D

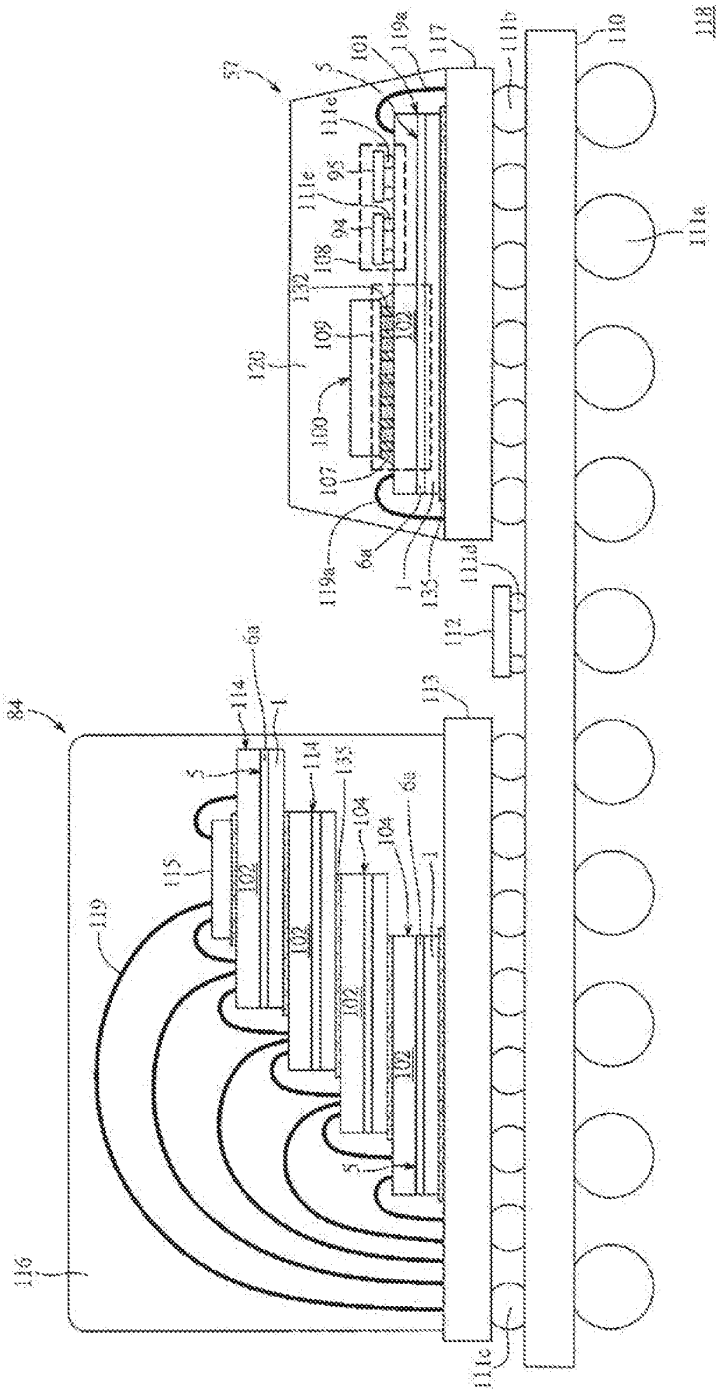

Fig. 36A

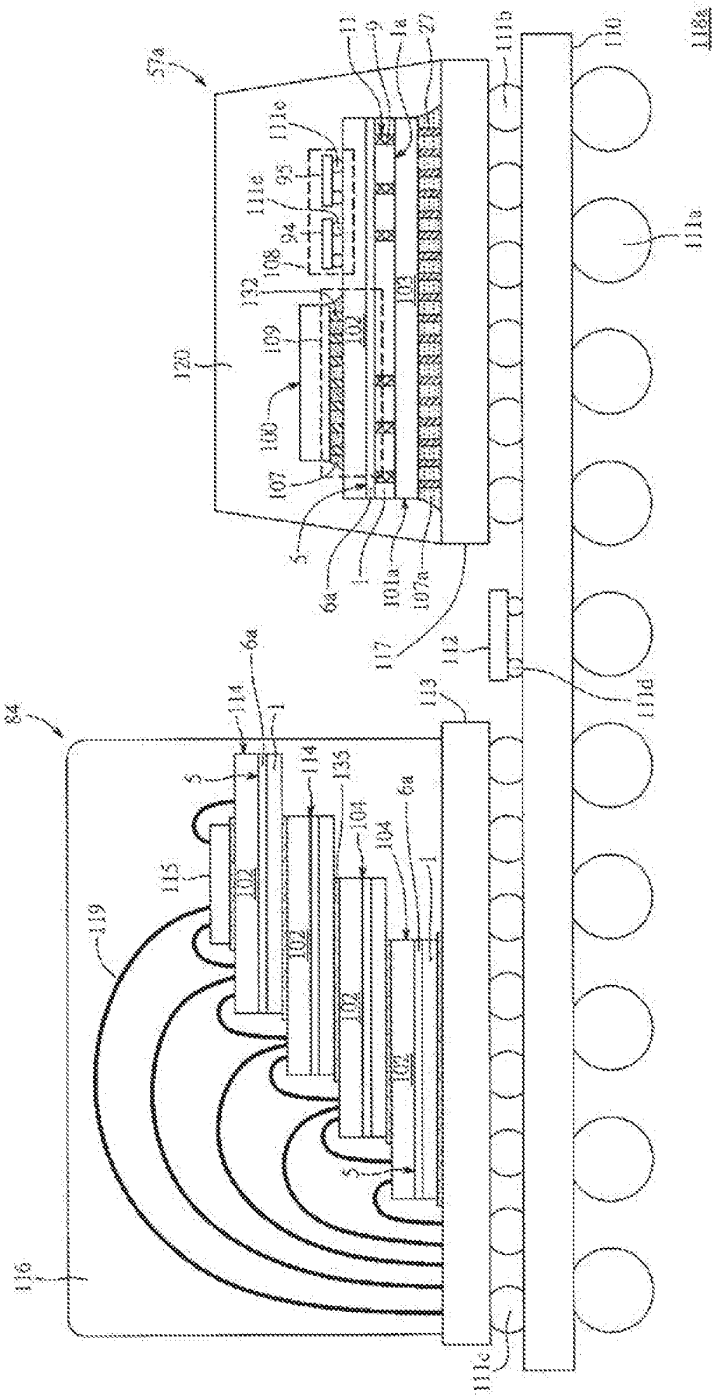

Fig. 36B

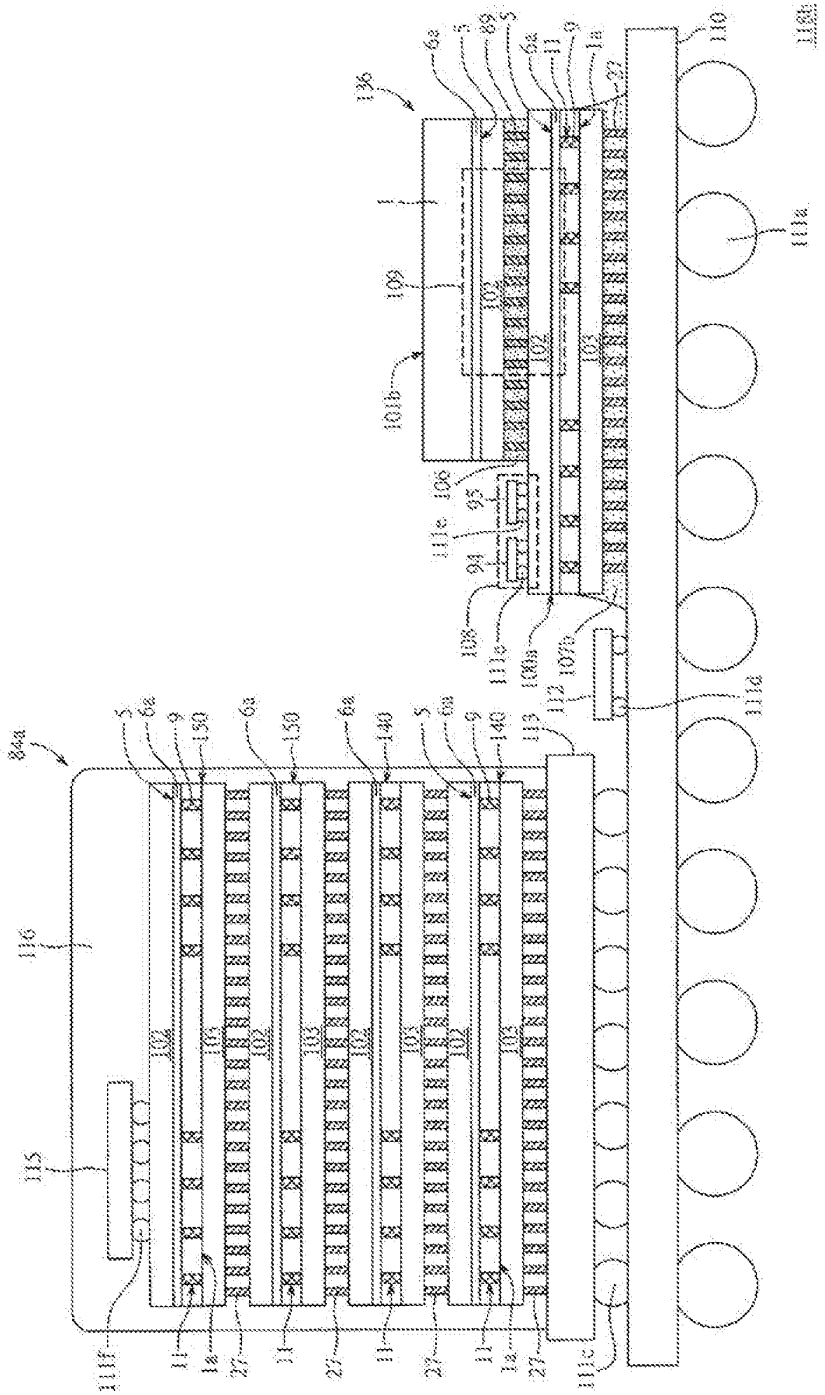

Fig. 36C

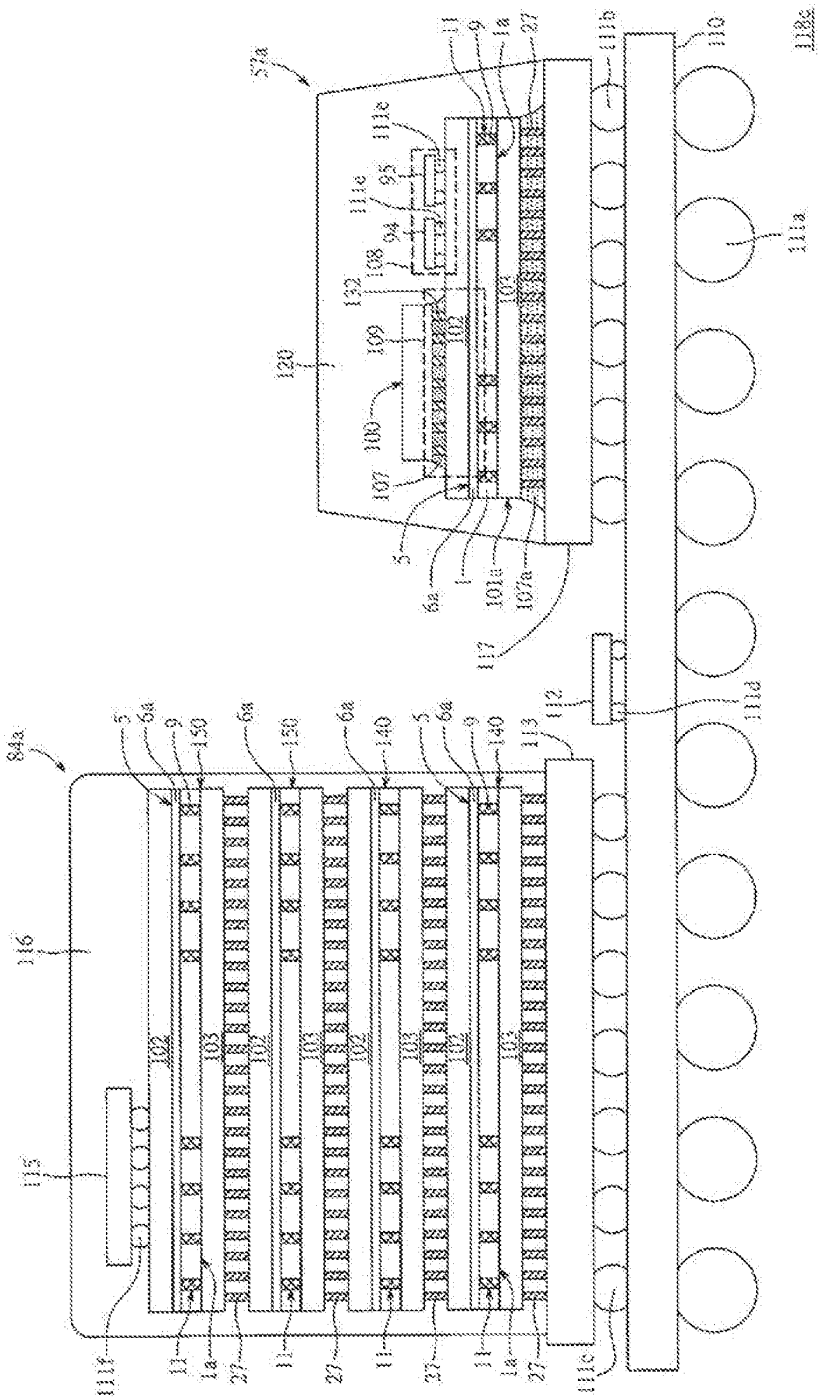

Fig. 36D

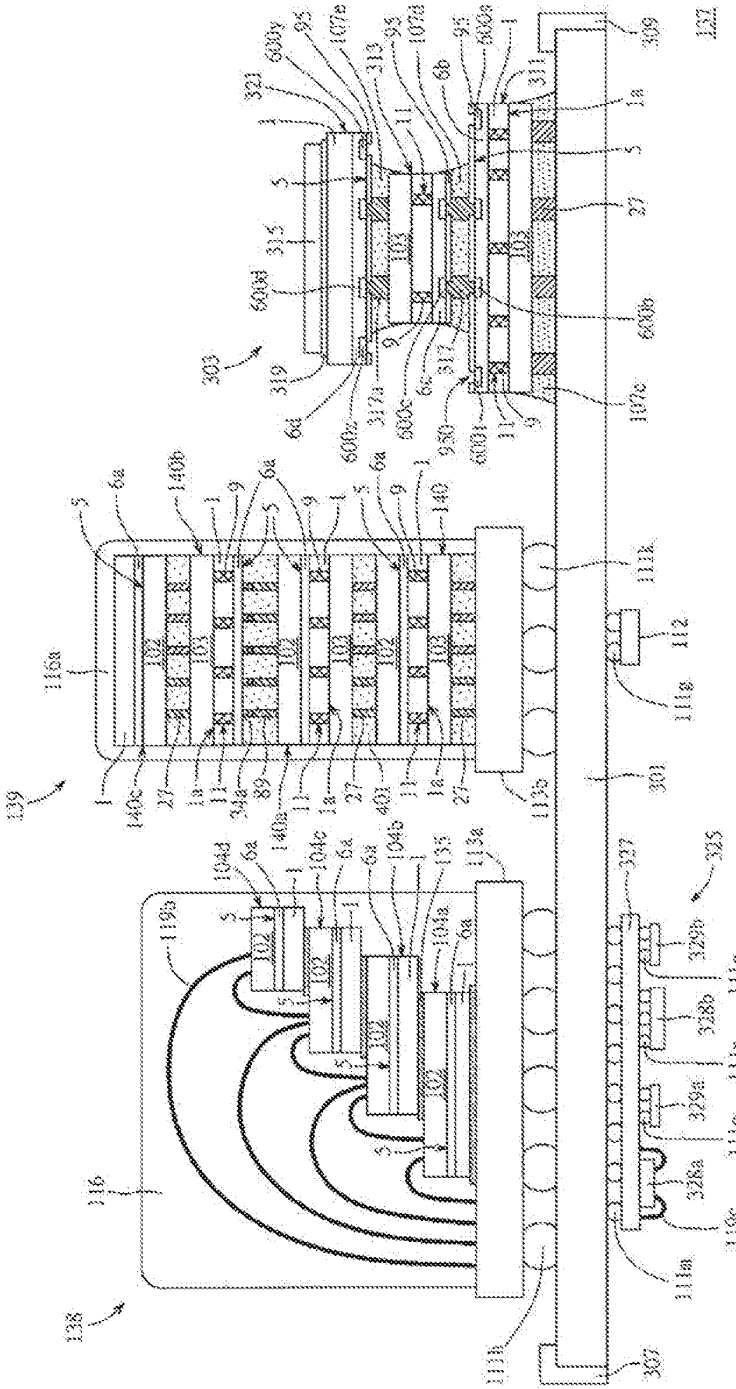

Fig. 37A

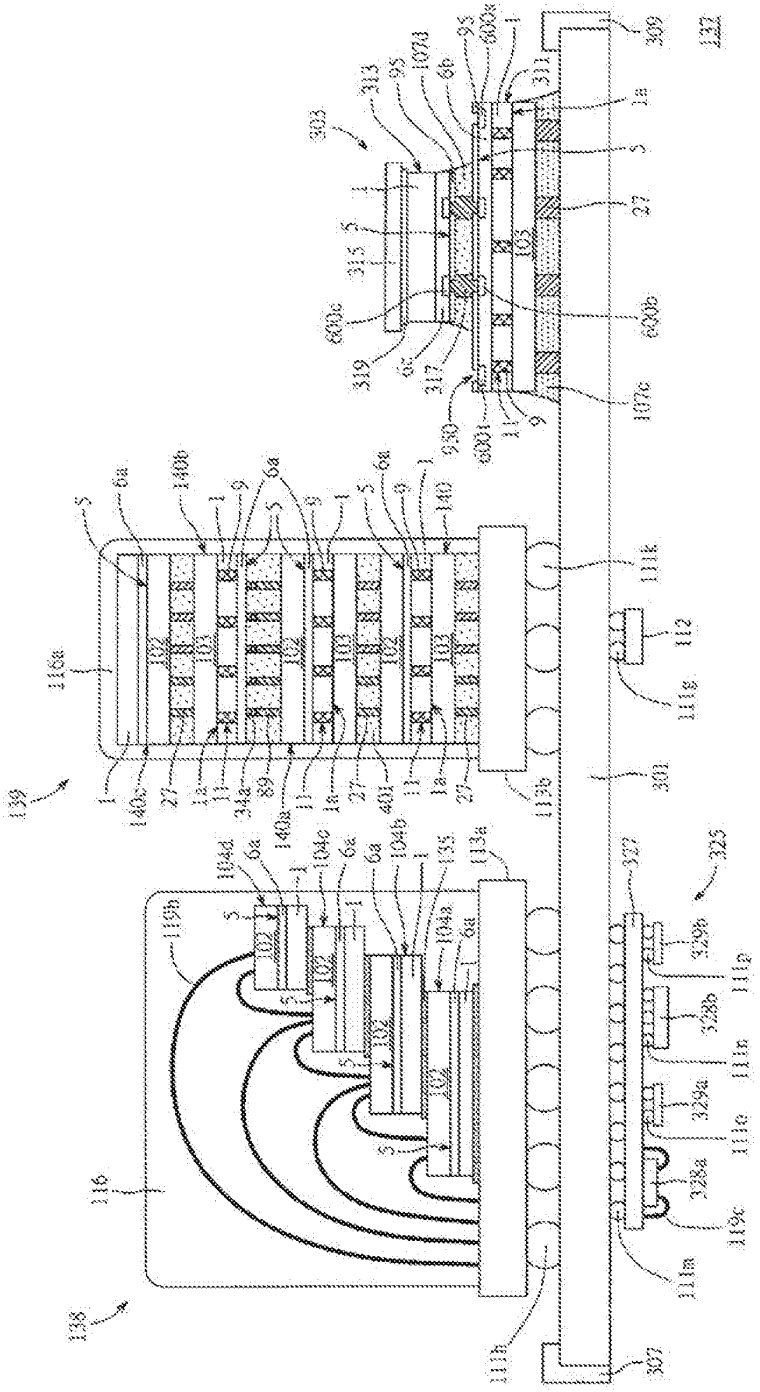

Fig. 37B

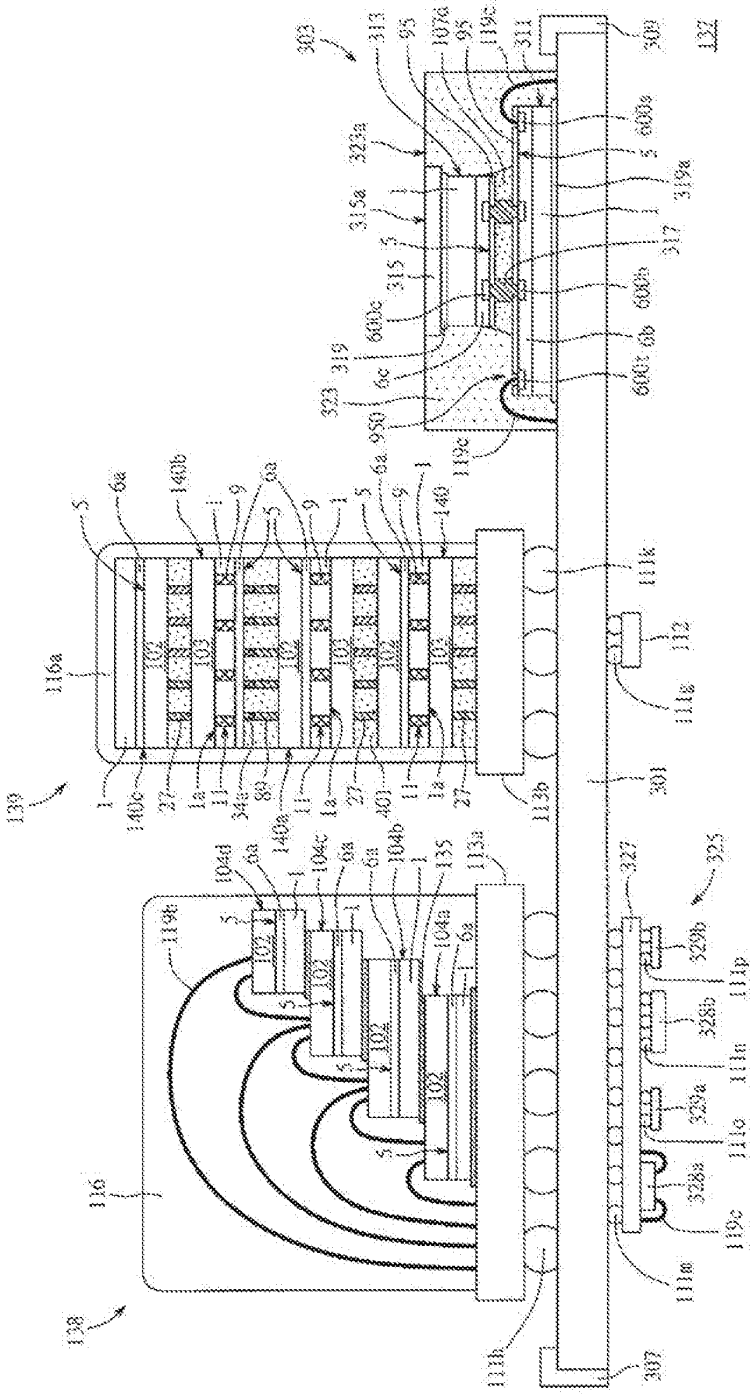

Fig. 37C

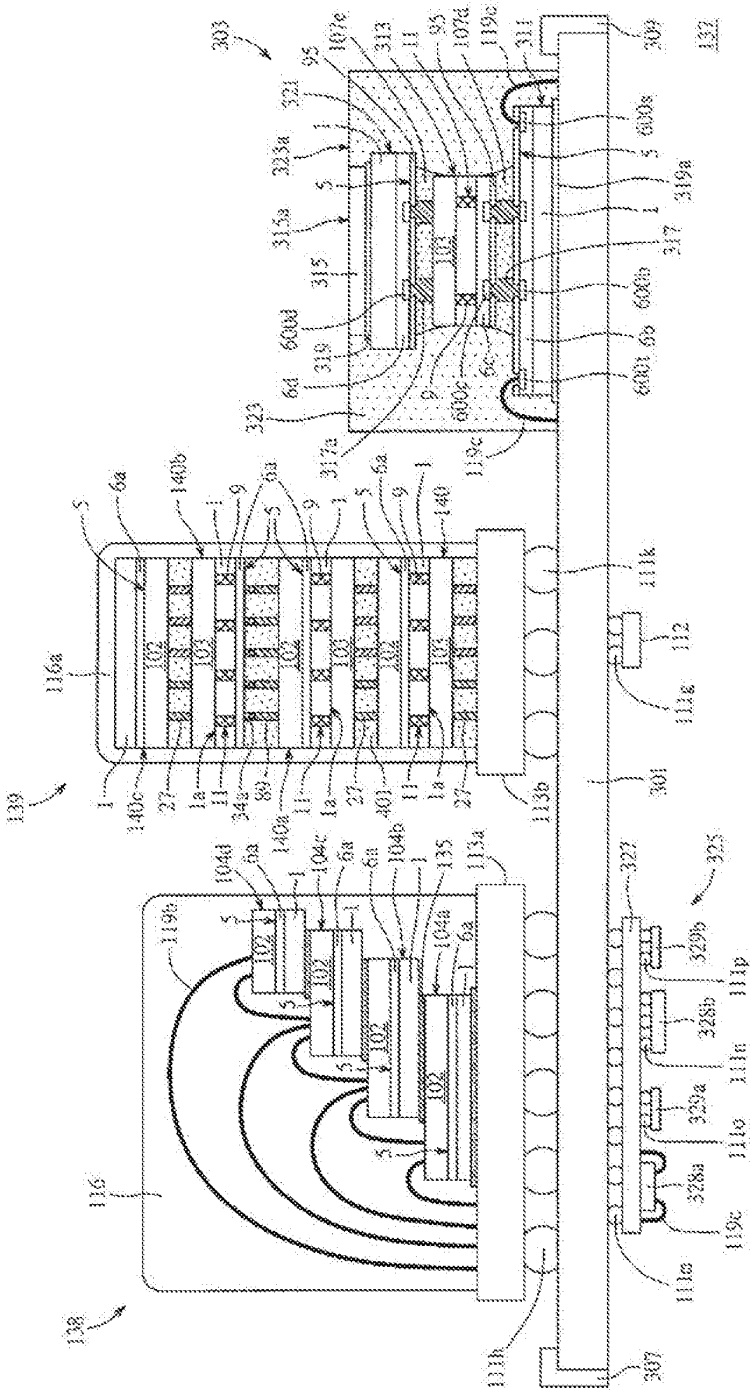

Fig. 37D

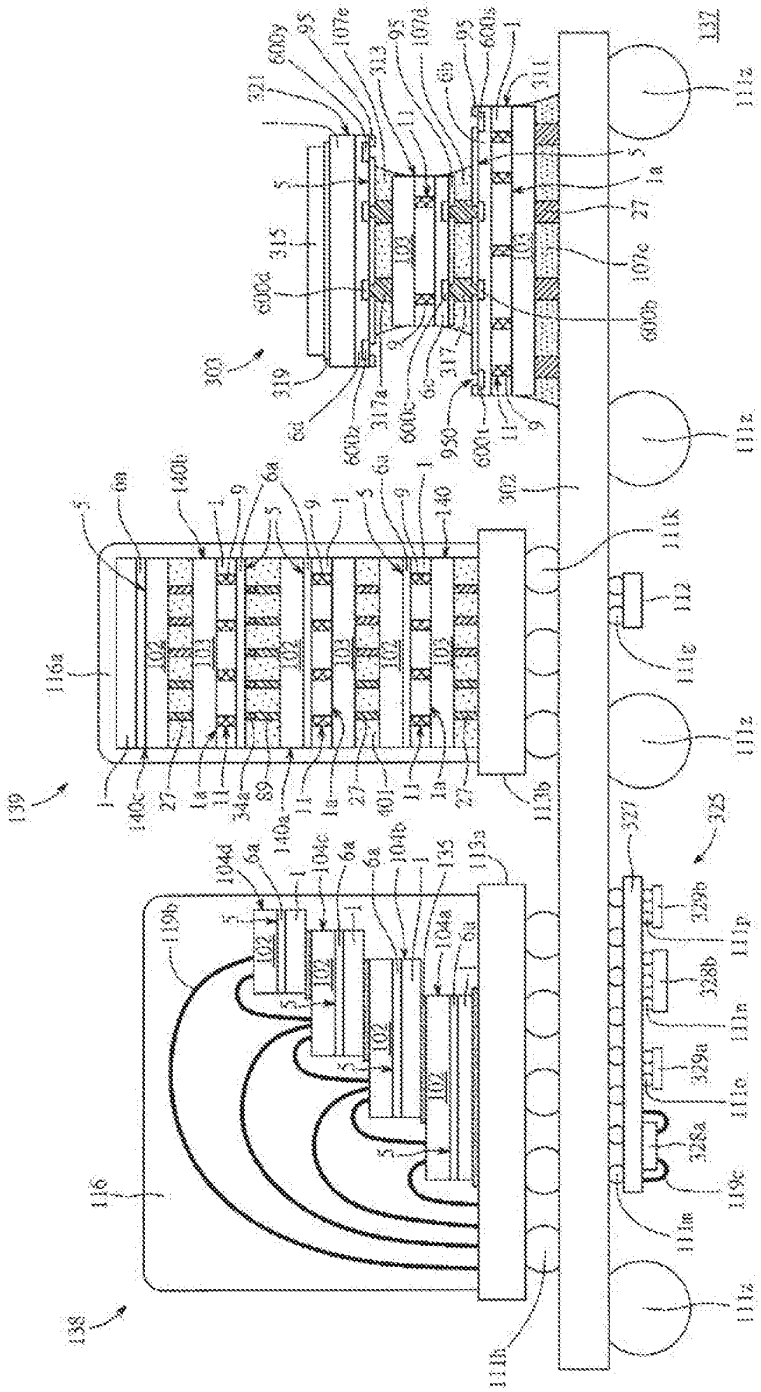

Fig. 38A

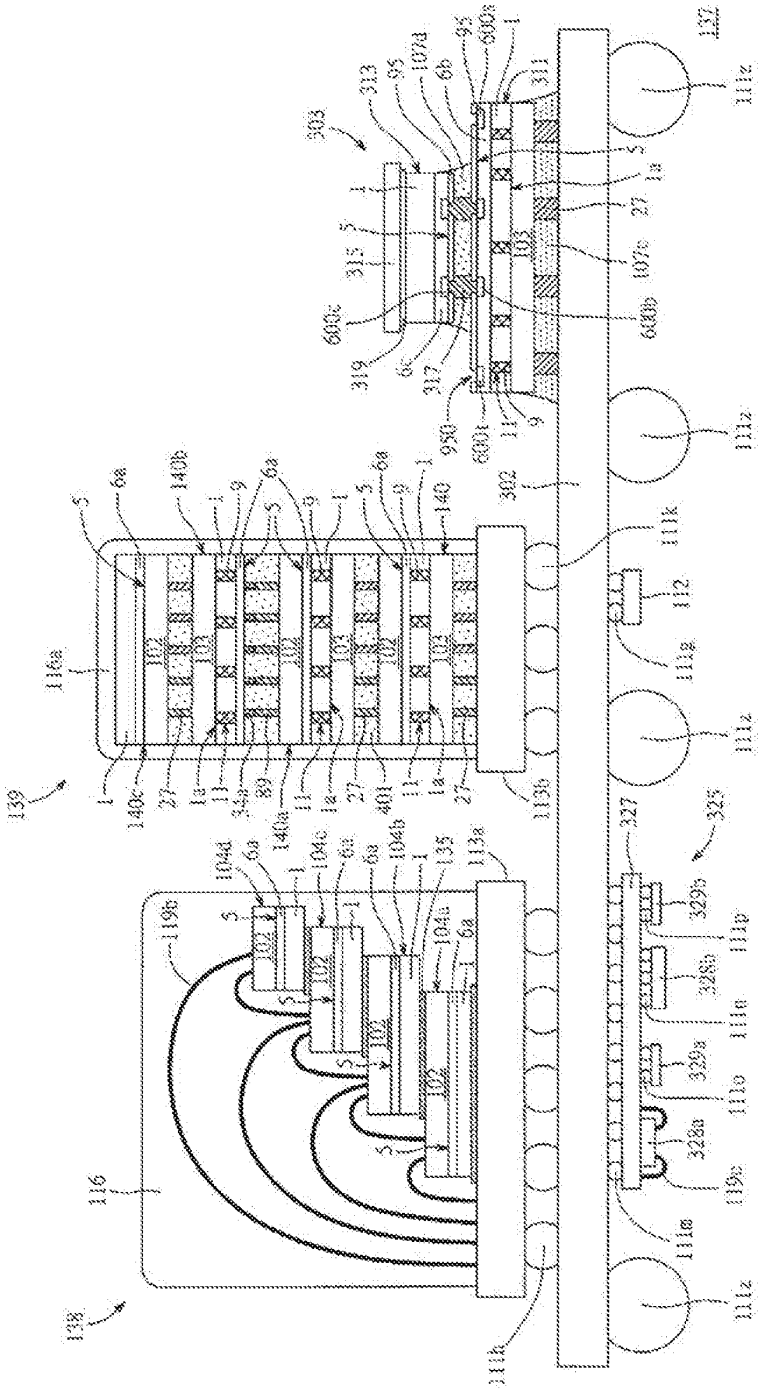

Fig. 38B

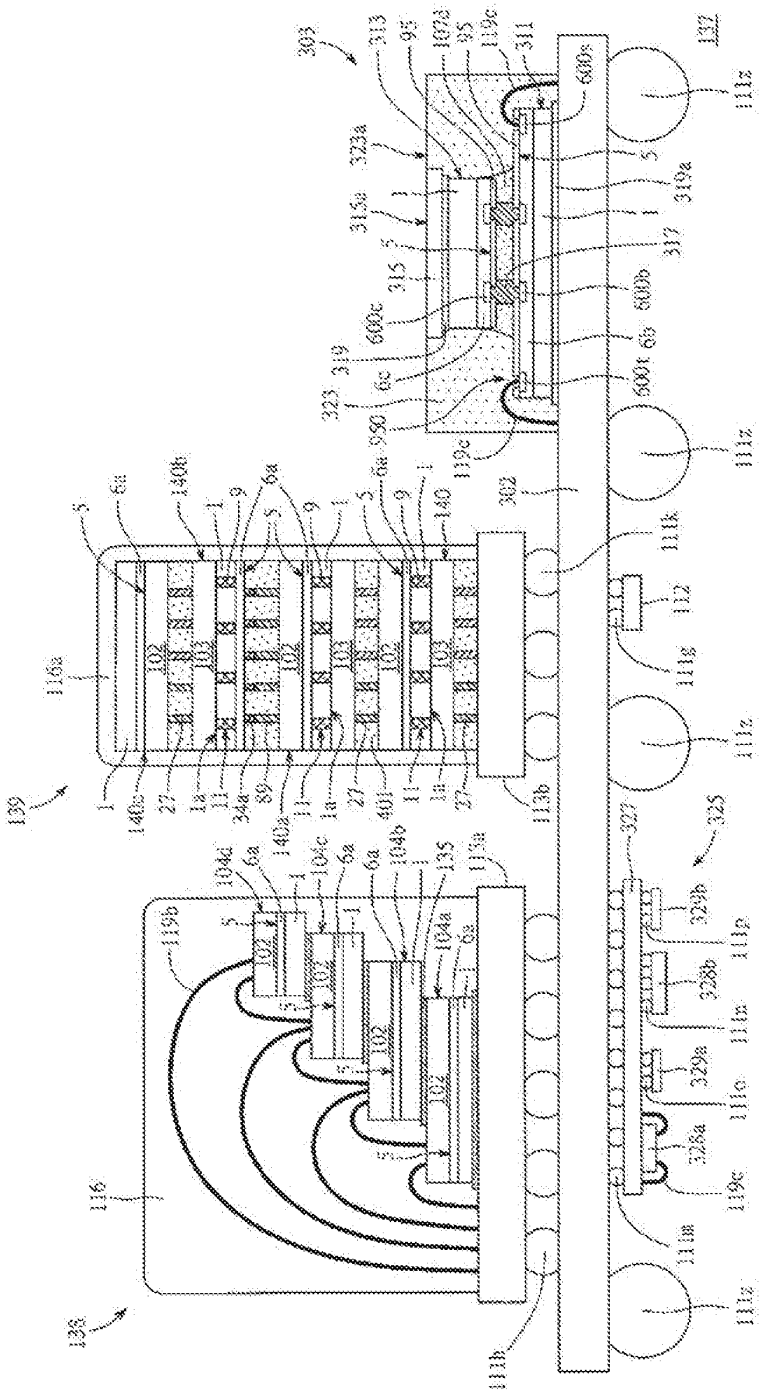

Fig. 38C

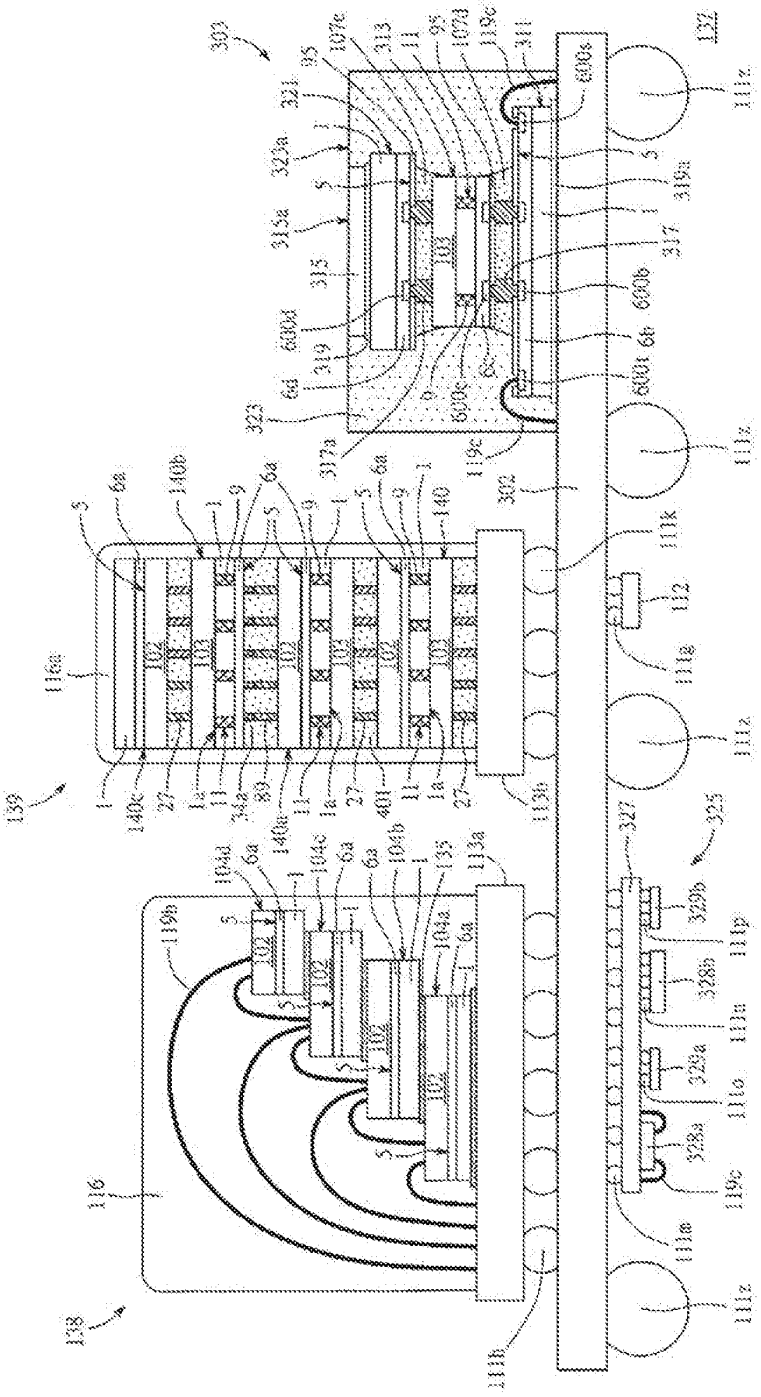

Fig. 38D

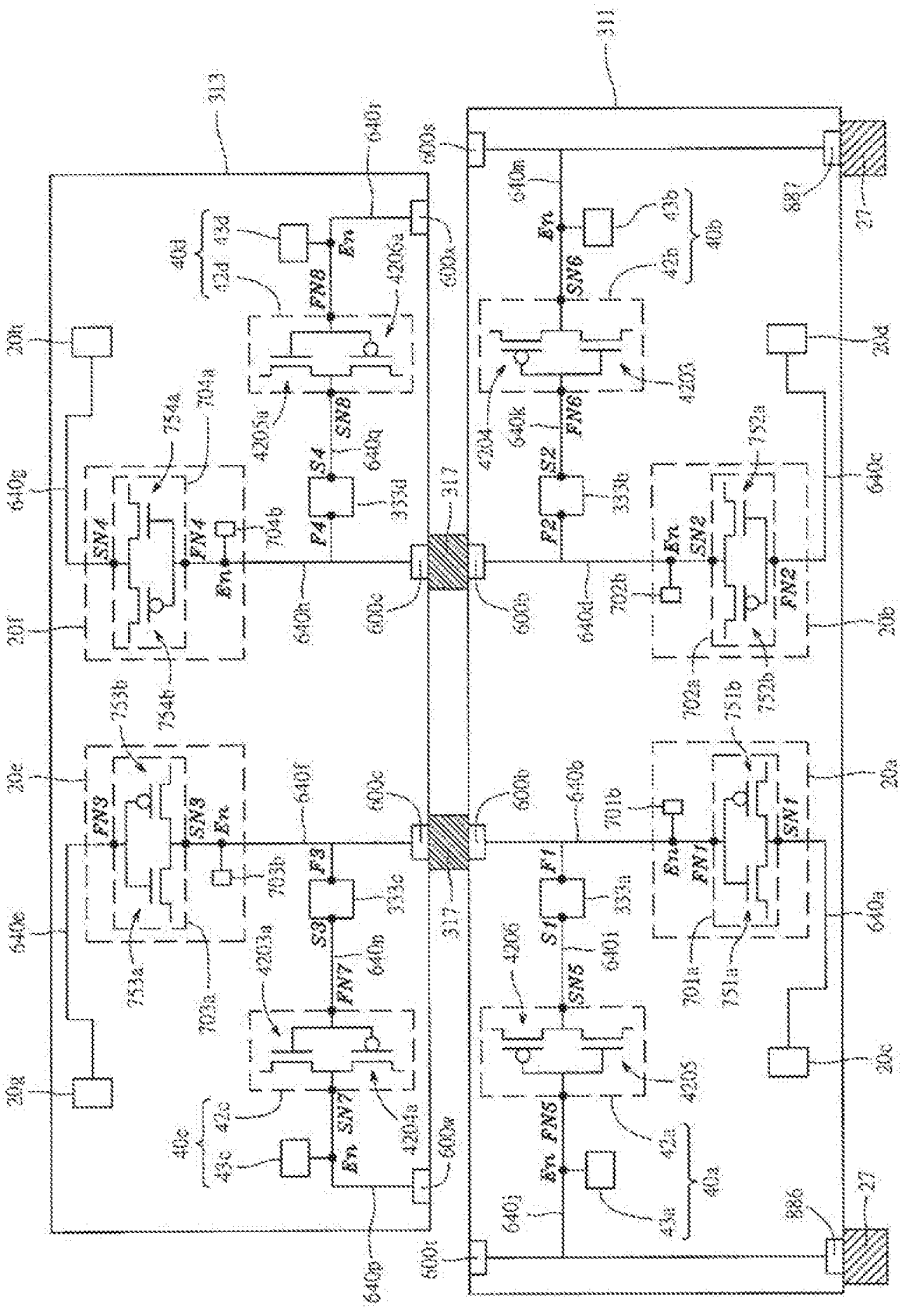

Fig. 39A

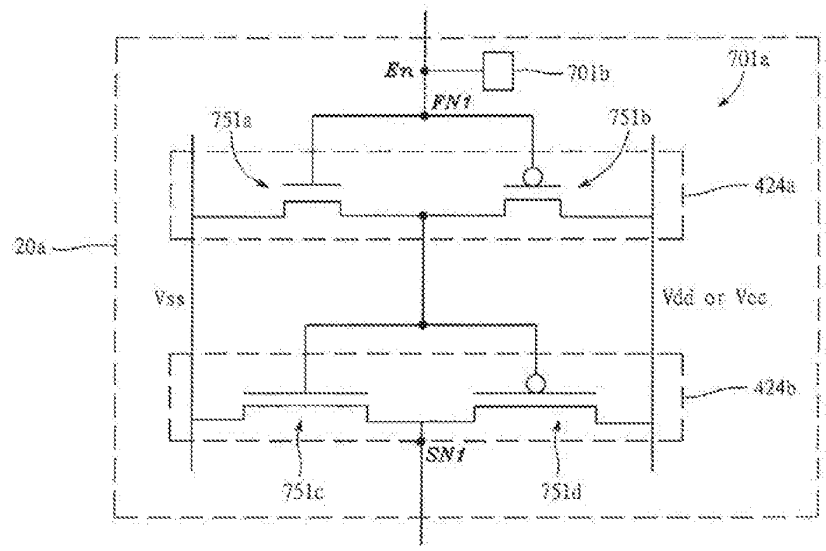

Fig. 39B

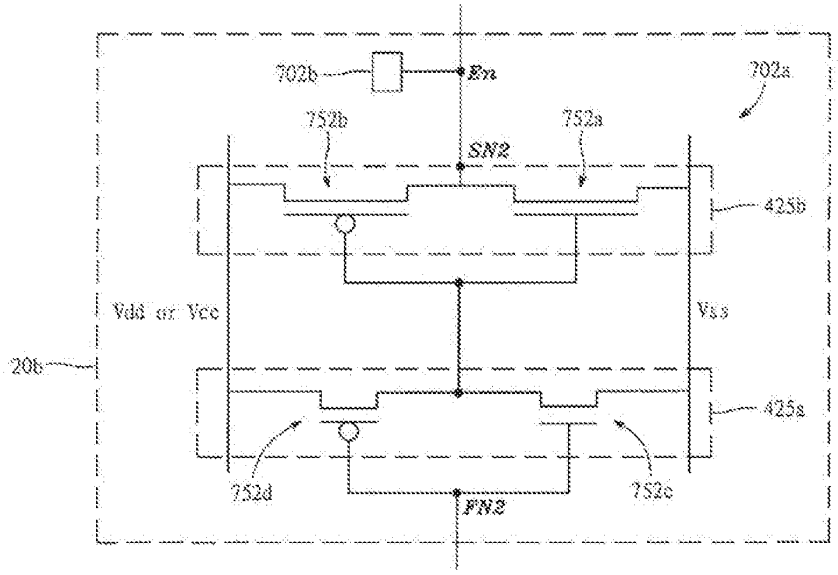

Fig. 39C

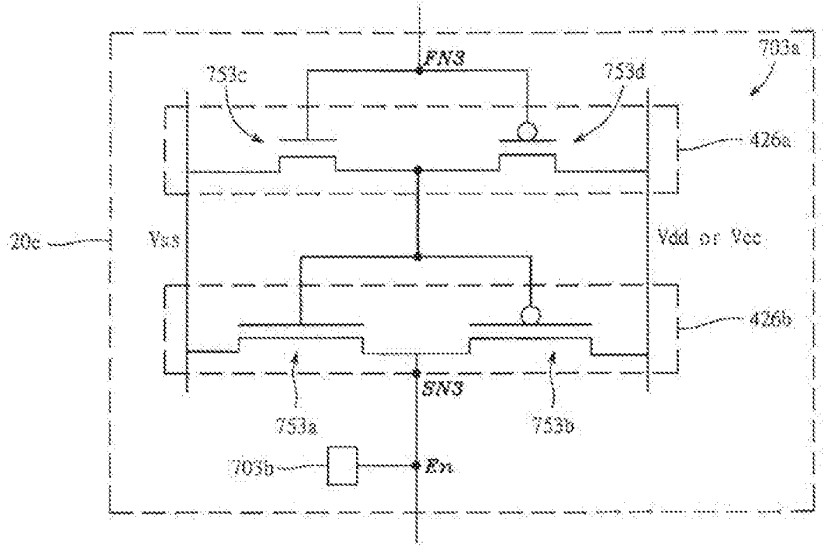

Fig. 39D

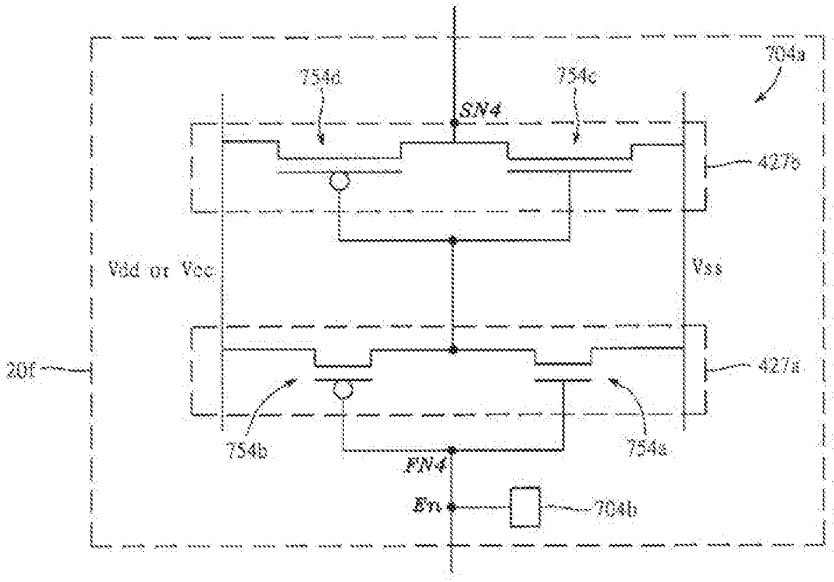

Fig. 39E

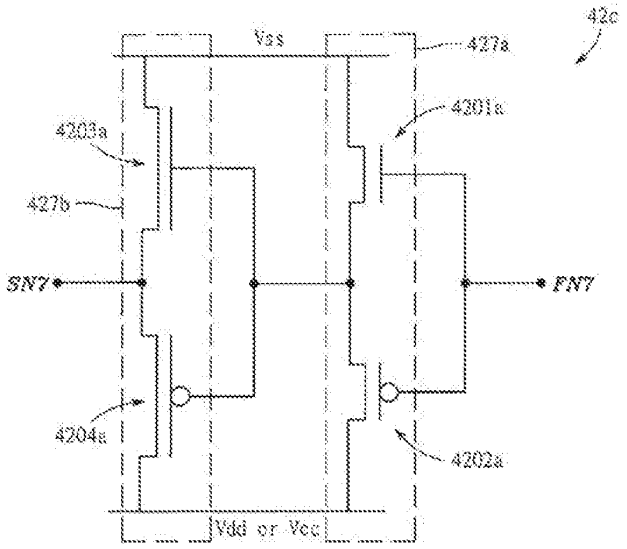

Fig. 39F

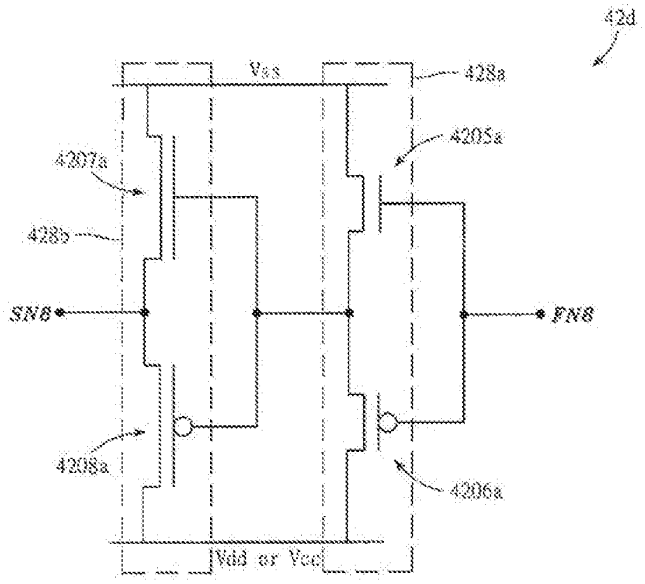

Fig. 39G

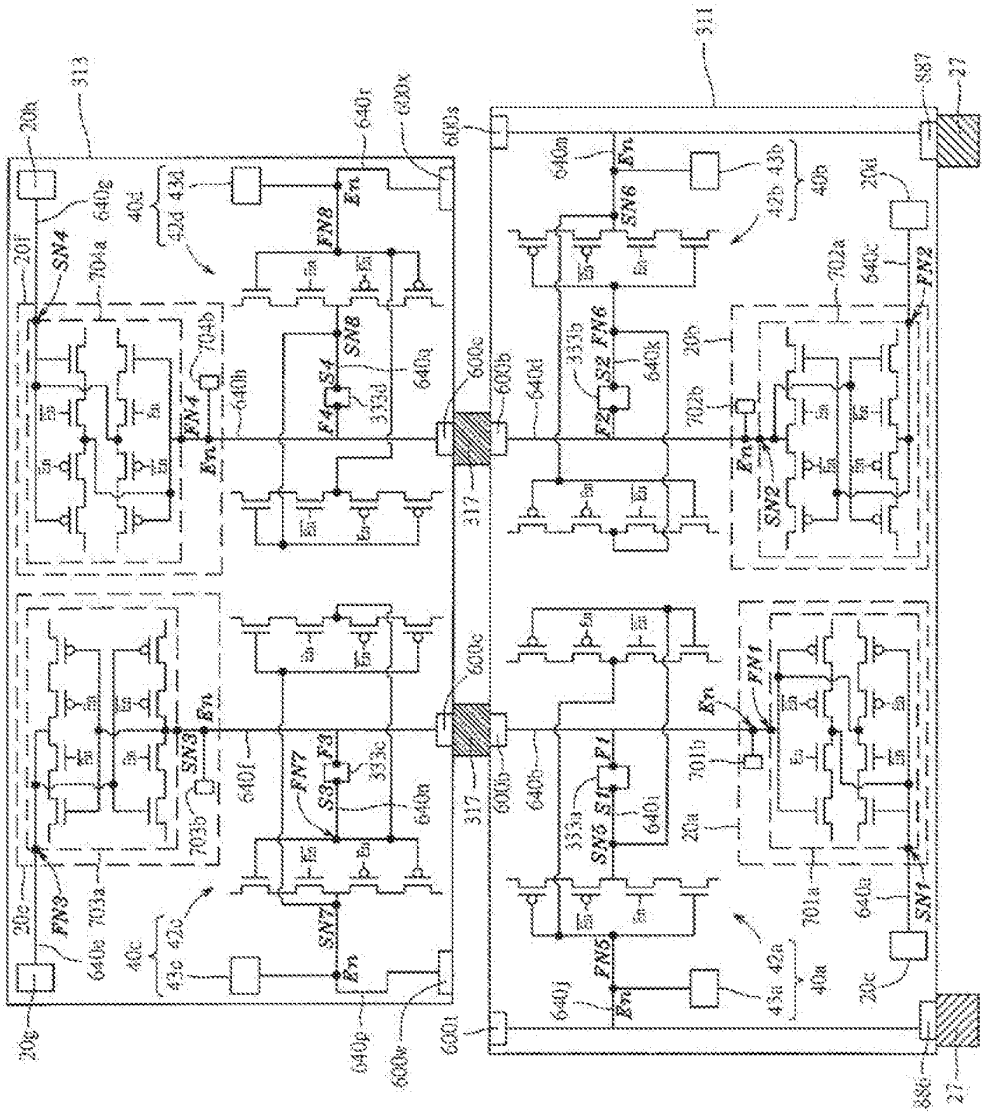

Fig. 39H

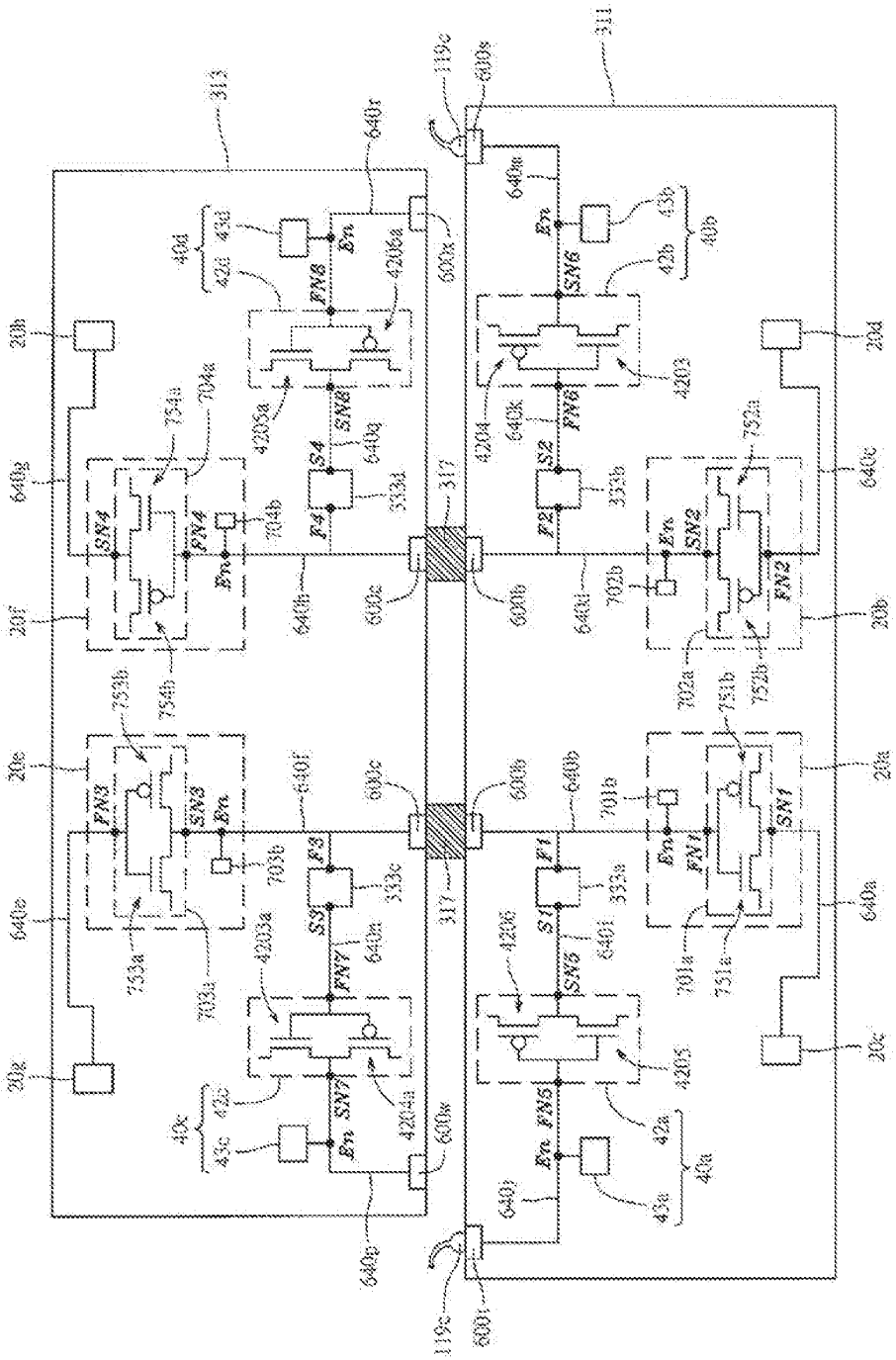

Fig. 39I

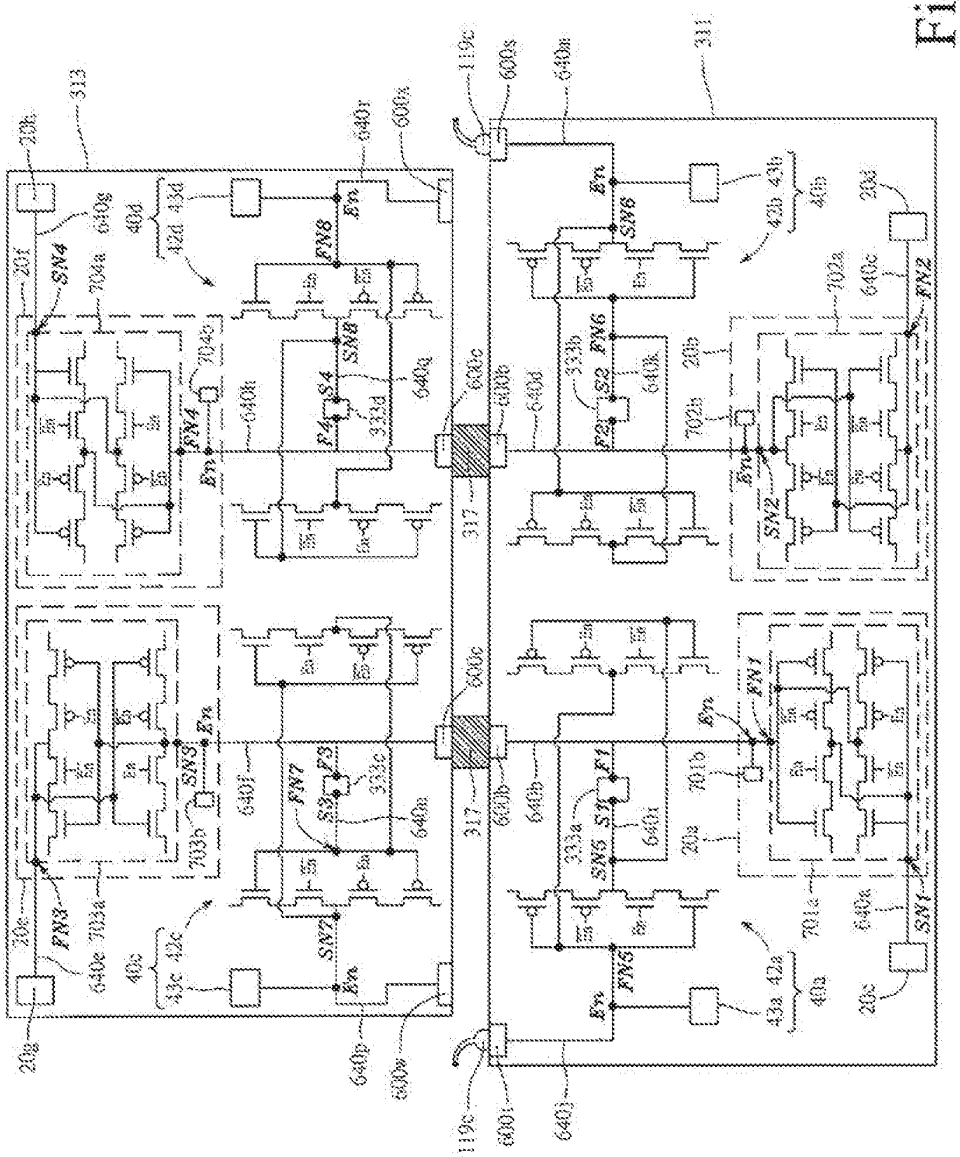

Fig. 39J

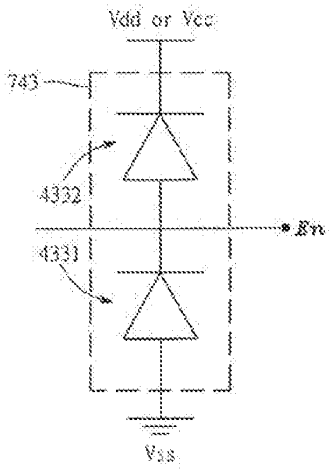

Fig. 40A

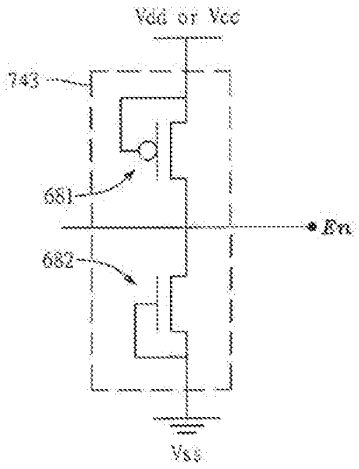

Fig. 40B

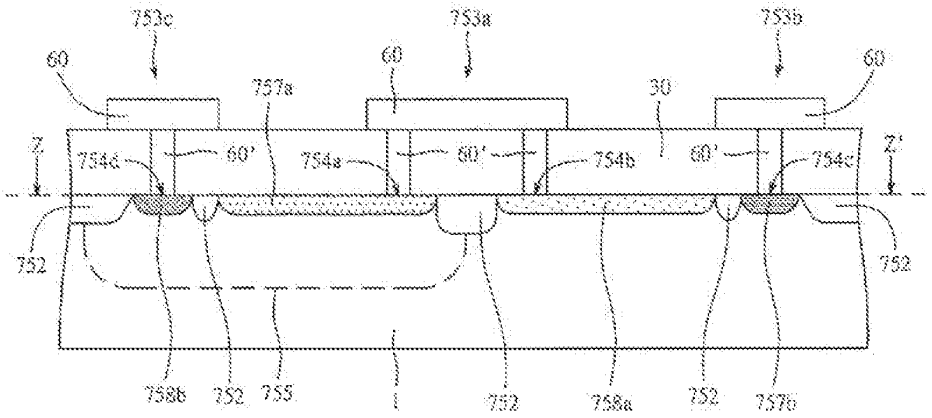

Fig. 40C

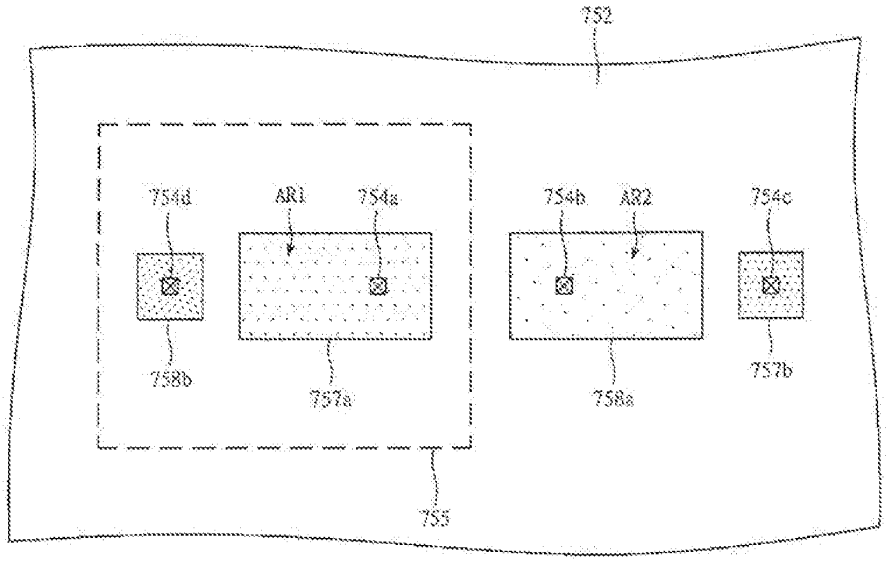

Fig. 40D

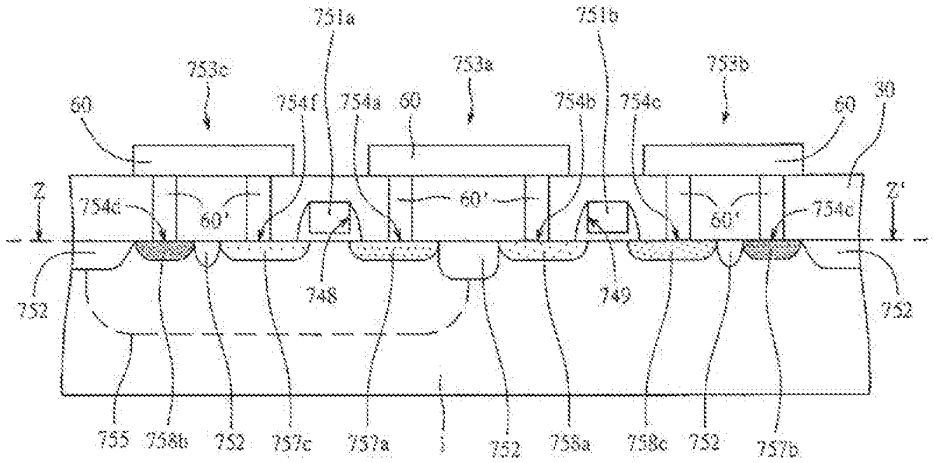

Fig. 40E

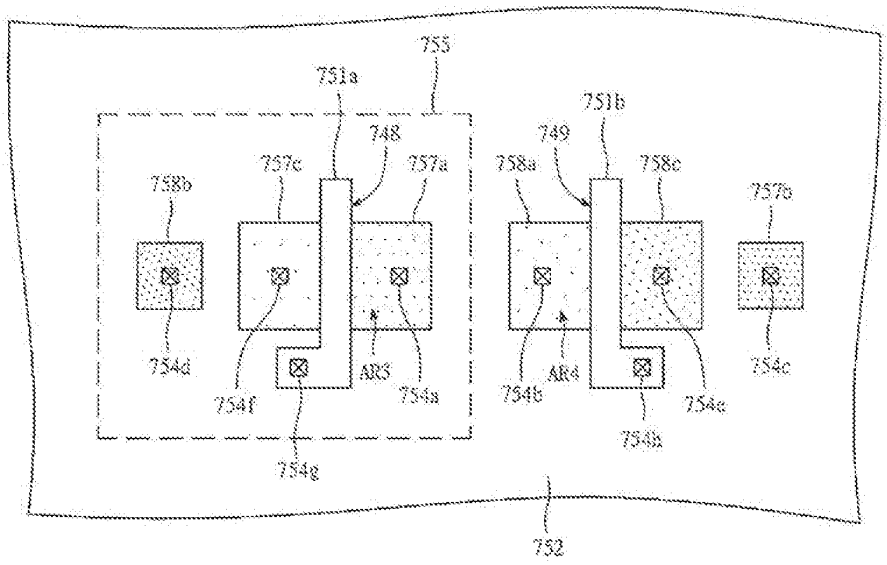

Fig. 40F

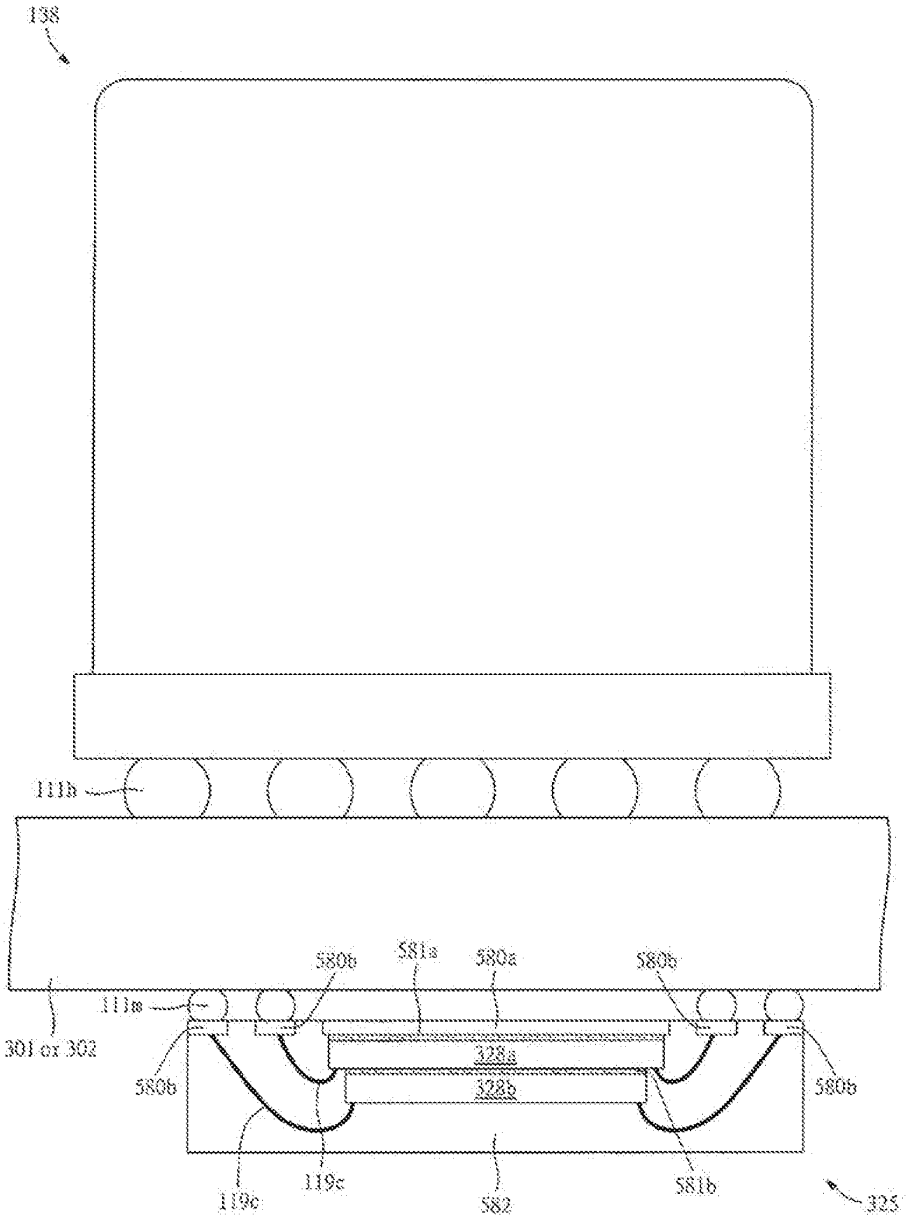
138
111b
580b
581a
580a
580b
111a
301 or 302
328a
328b
580b
580b
119c
119c
582
581b
325

Fig. 41

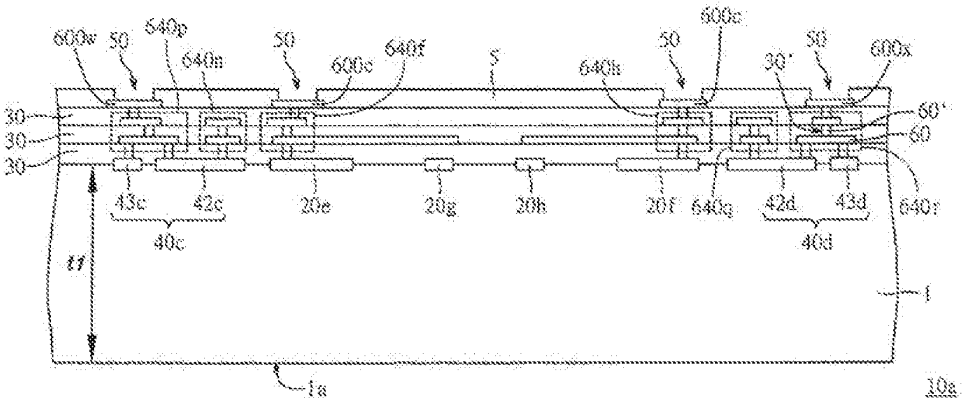

Fig. 42A

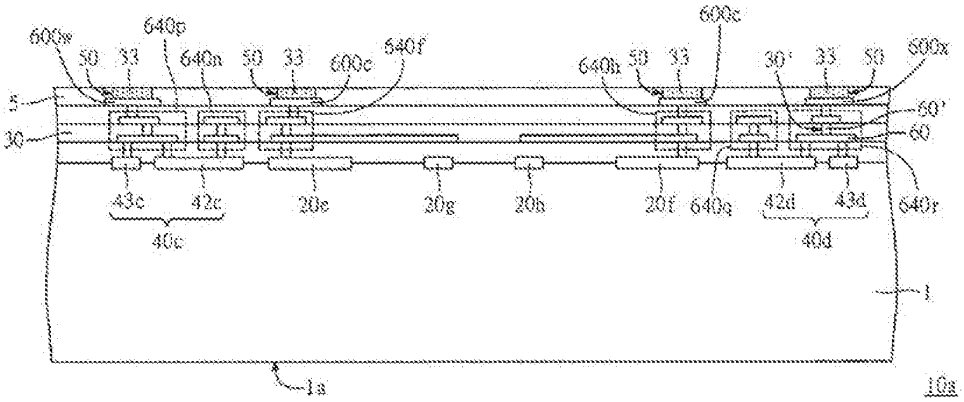

Fig. 42B

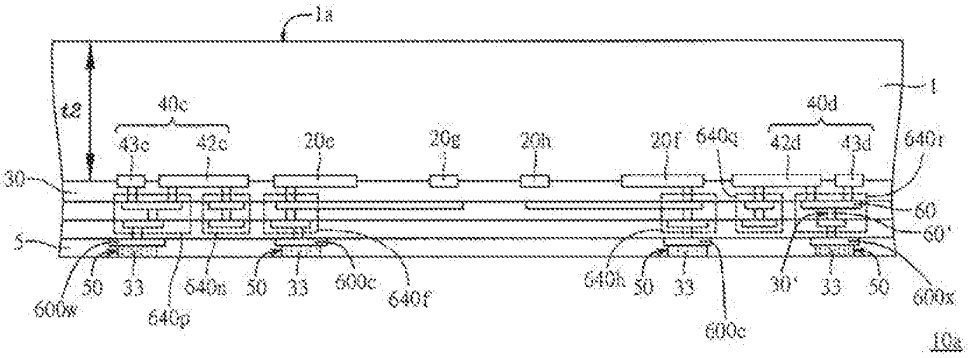

Fig. 42C

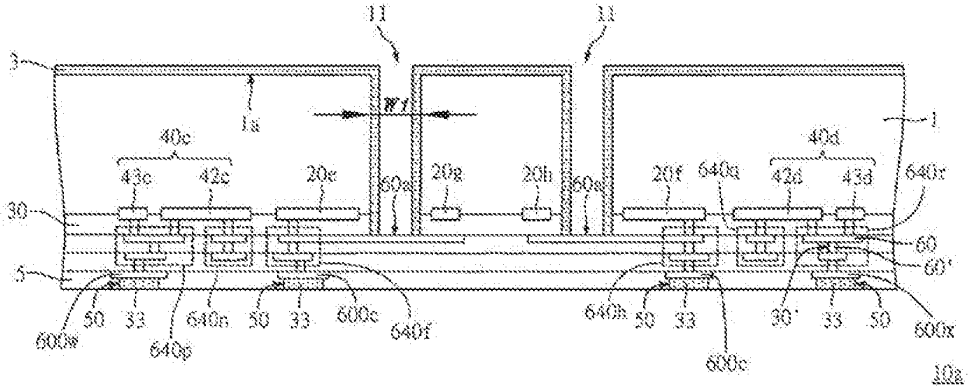

Fig. 42D

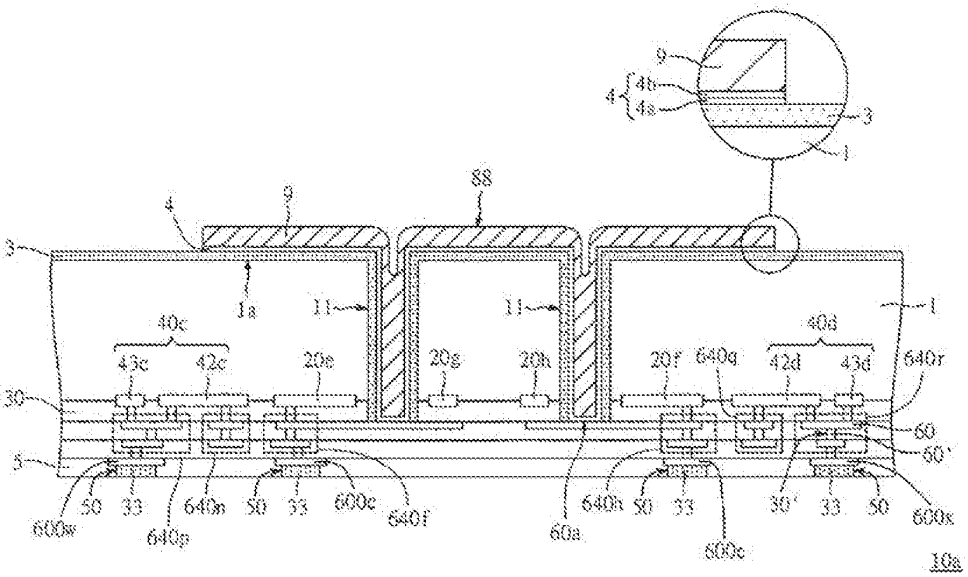

Fig. 42E

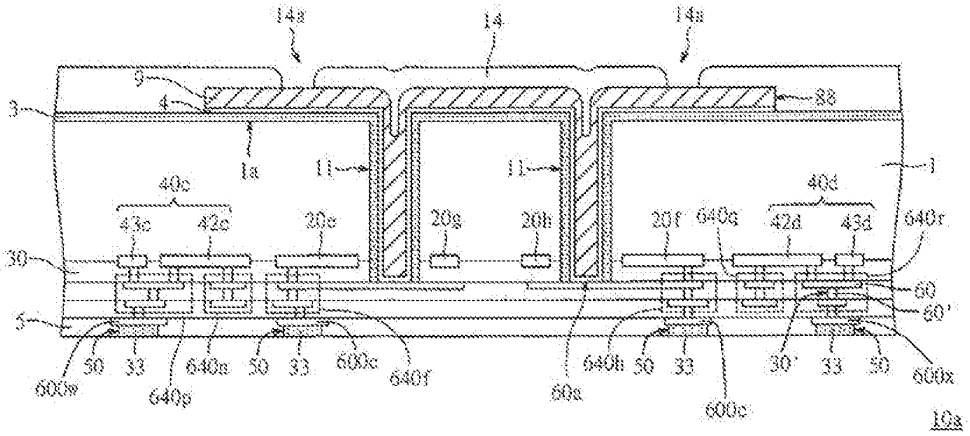

Fig. 42F

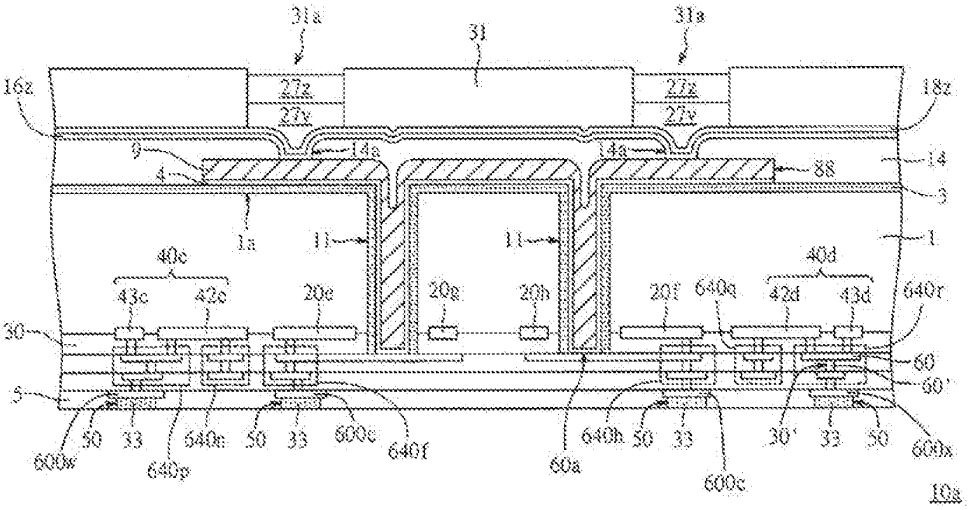

Fig. 42G

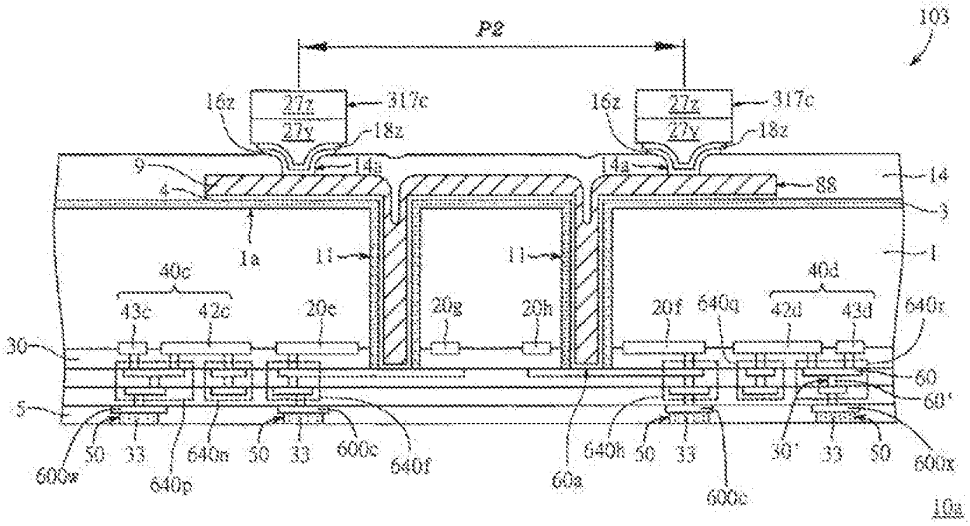

Fig. 42H

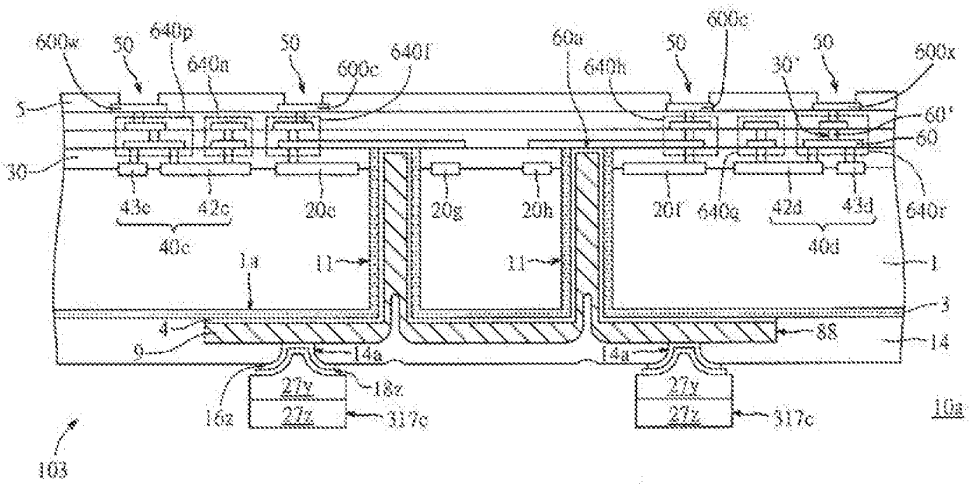

Fig. 42I

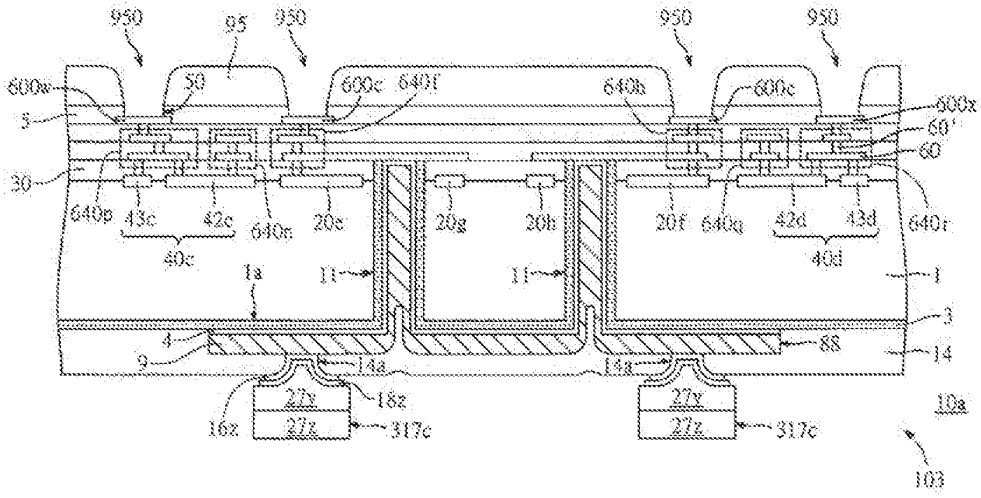

Fig. 42J

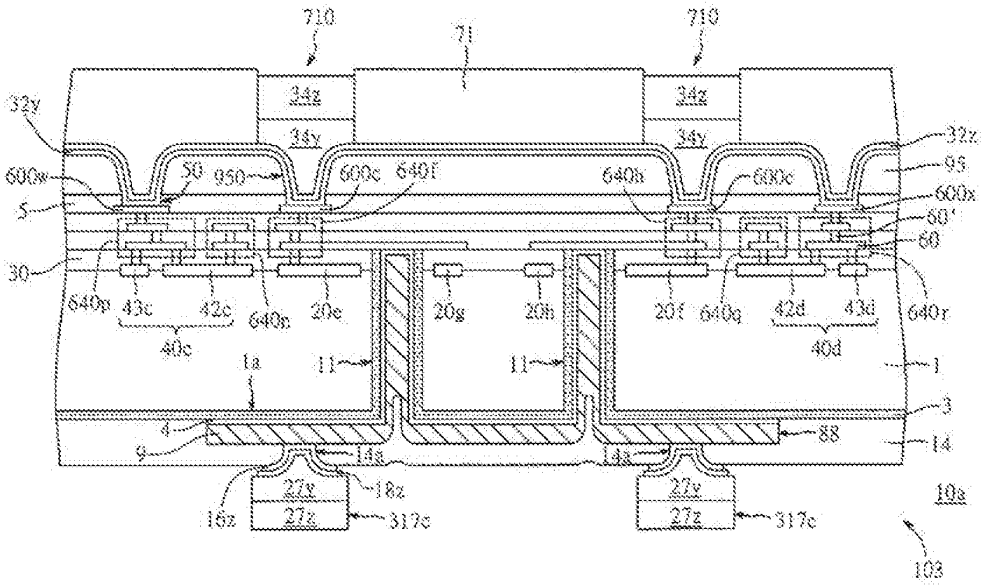

Fig. 42K

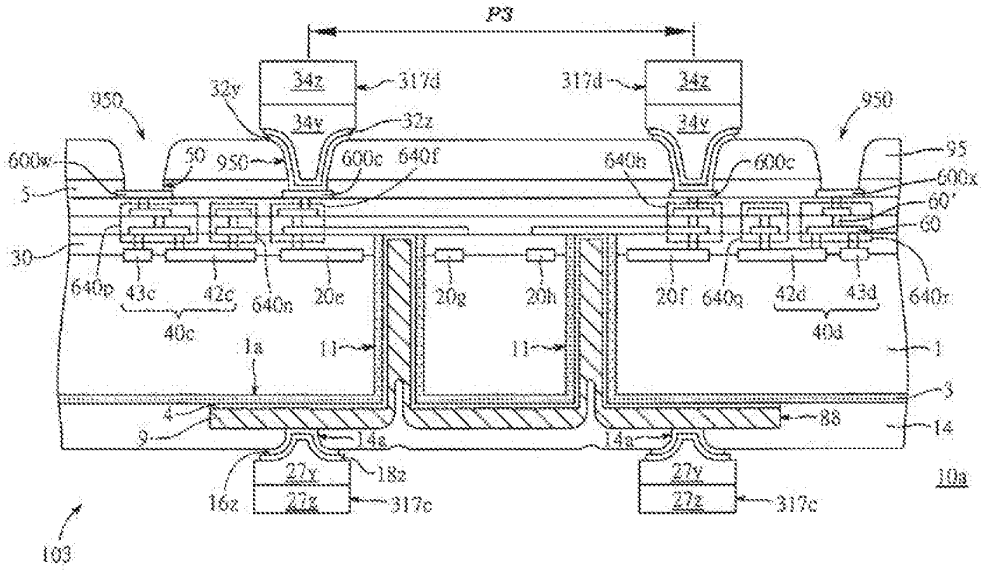

Fig. 42L

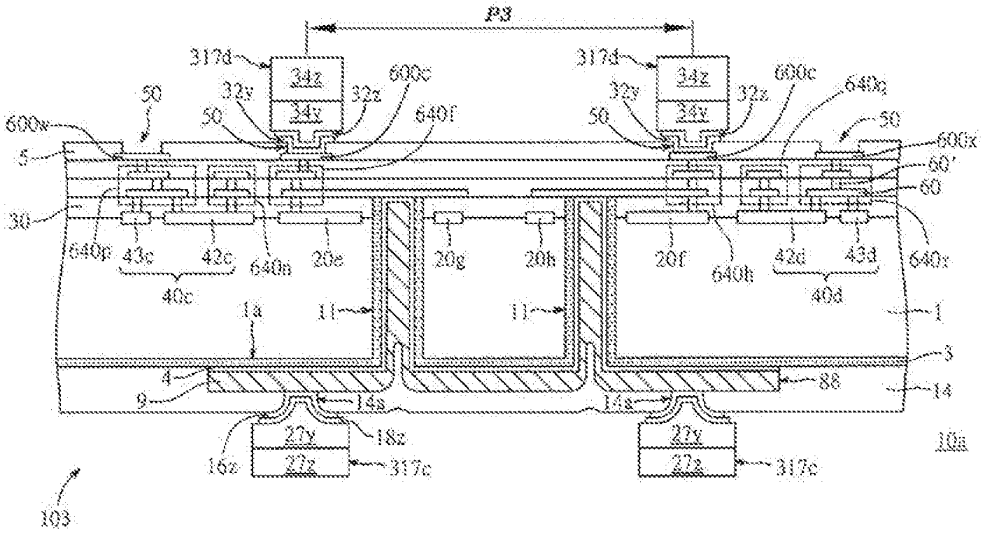

Fig. 42M

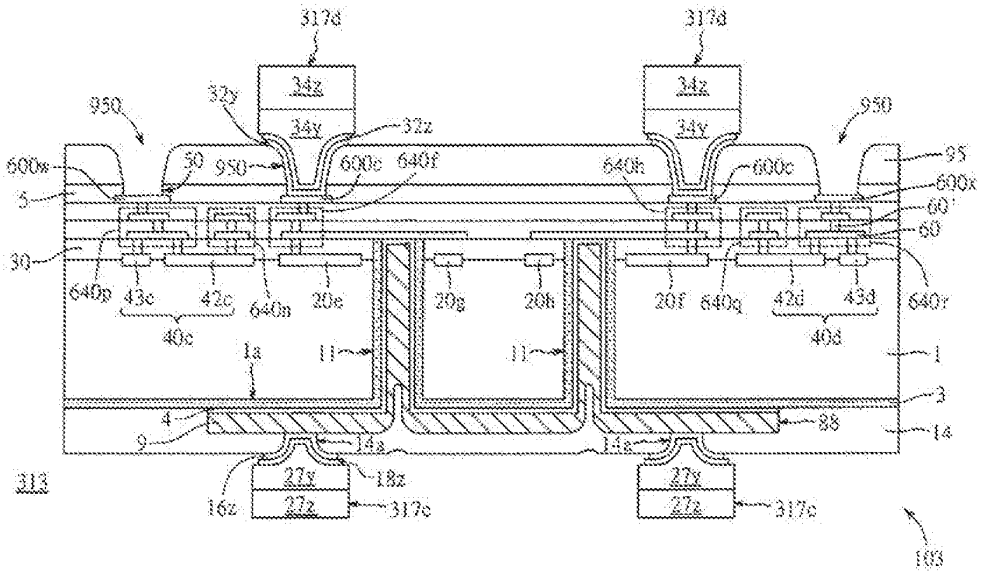

Fig. 42N

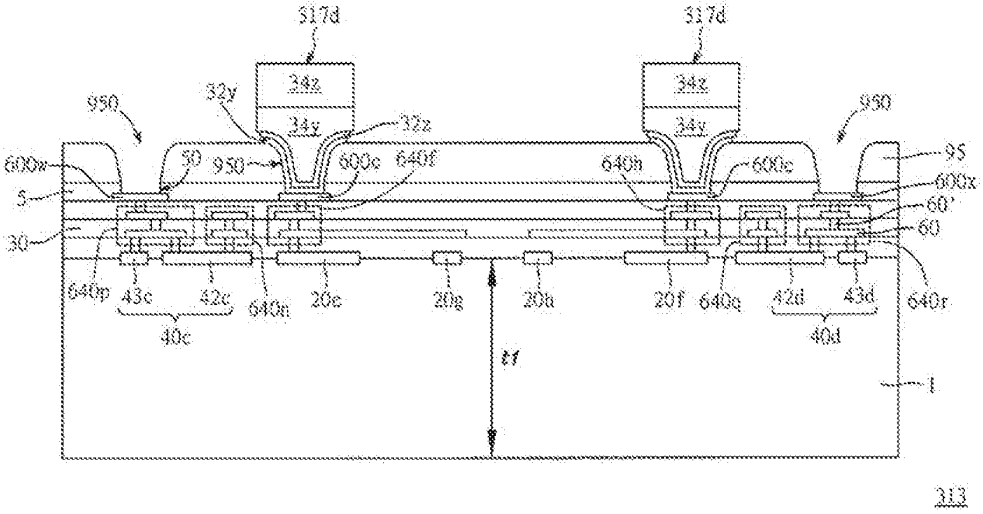

Fig. 42O

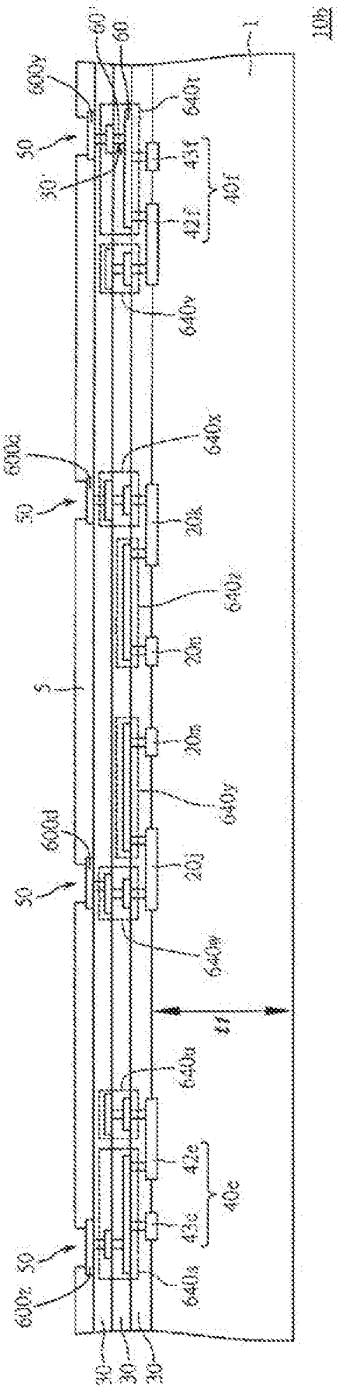

Fig. 43A

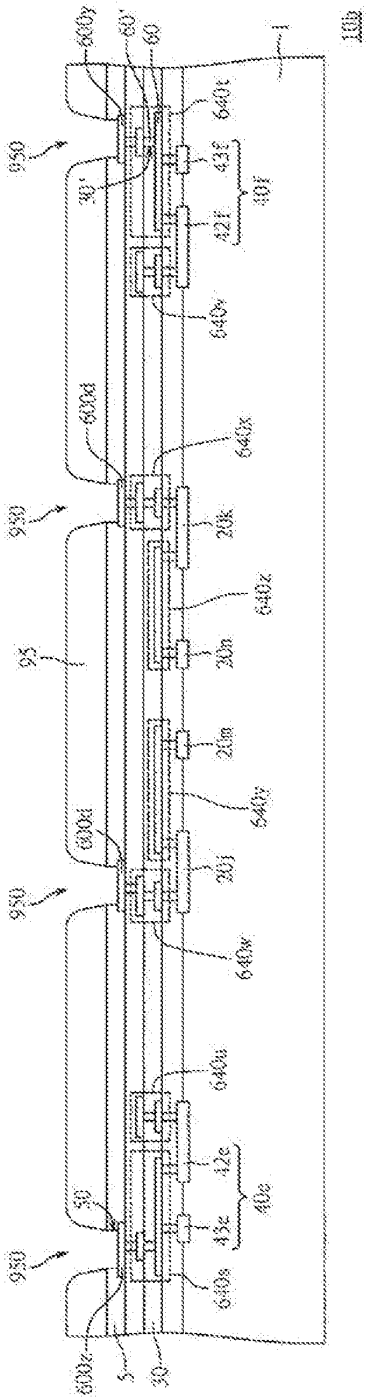

Fig. 43B

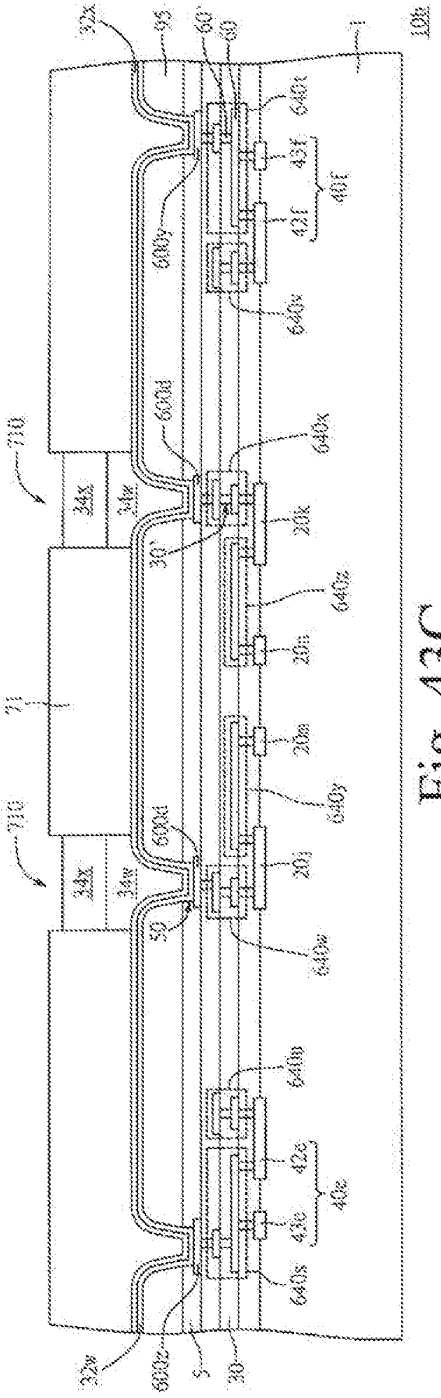

Fig. 43C

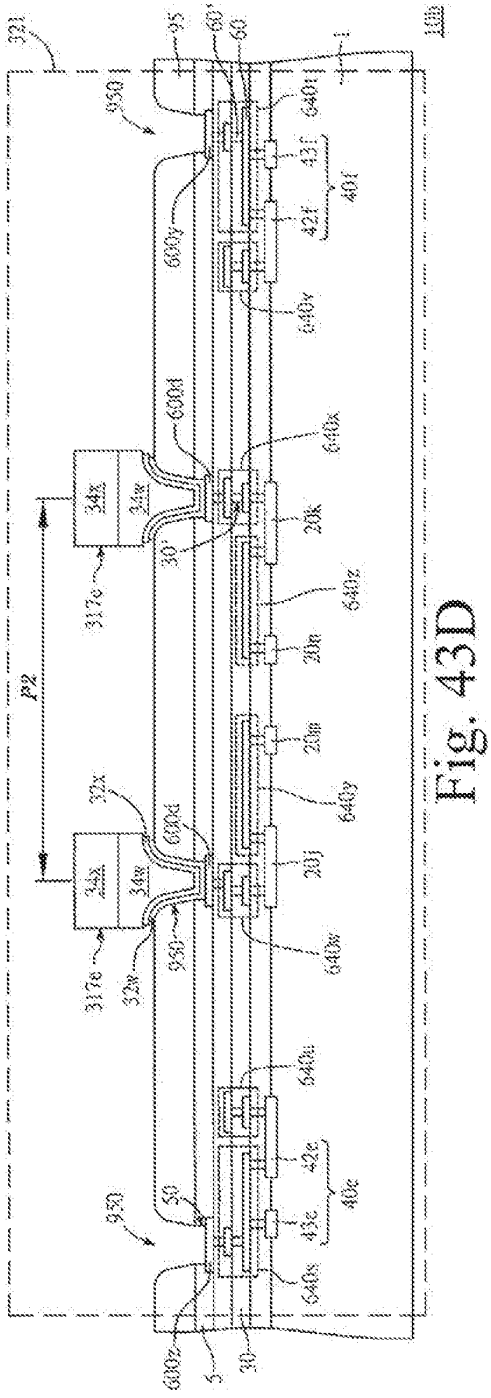

Fig. 43D

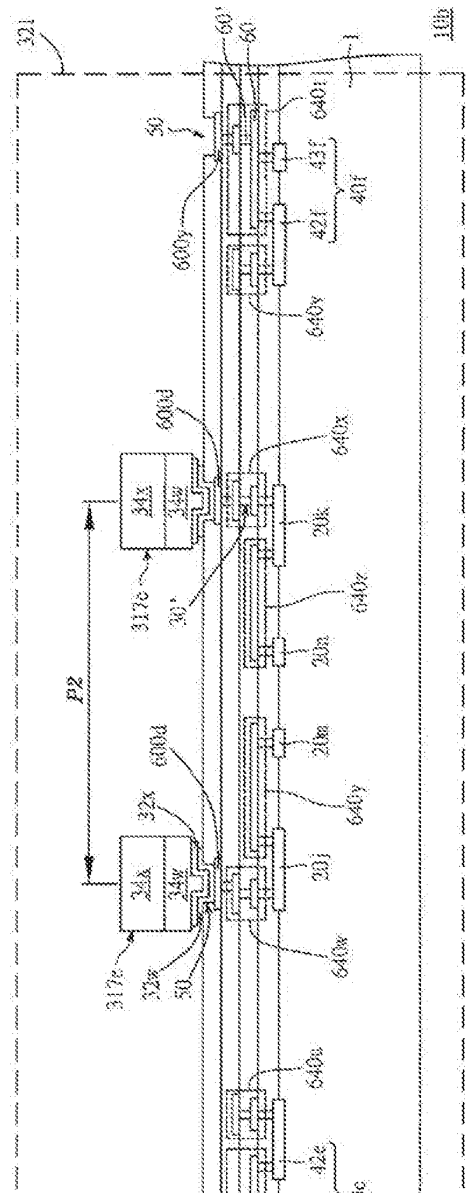
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Fig. 43E

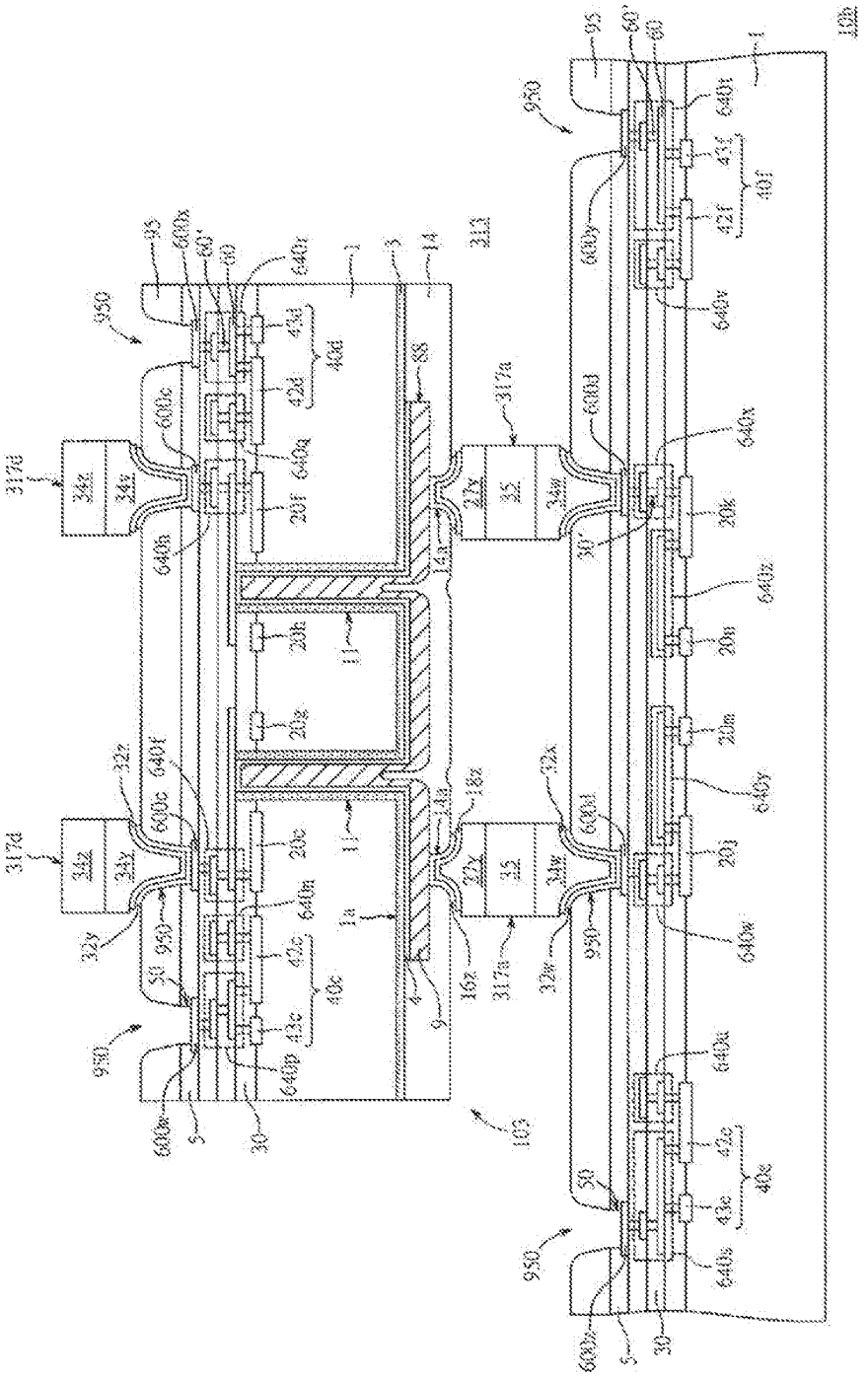

Fig. 44A

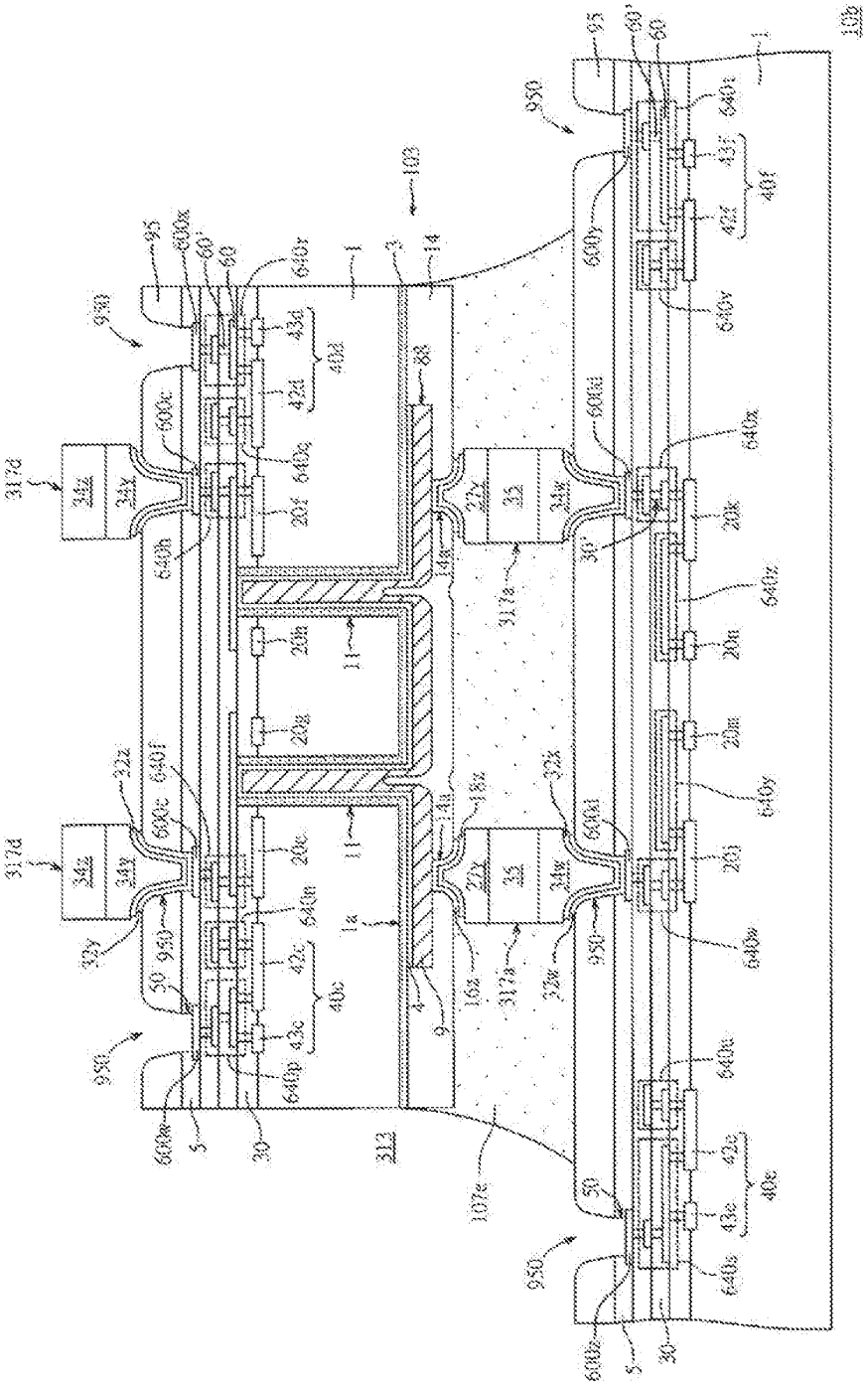

Fig. 44B

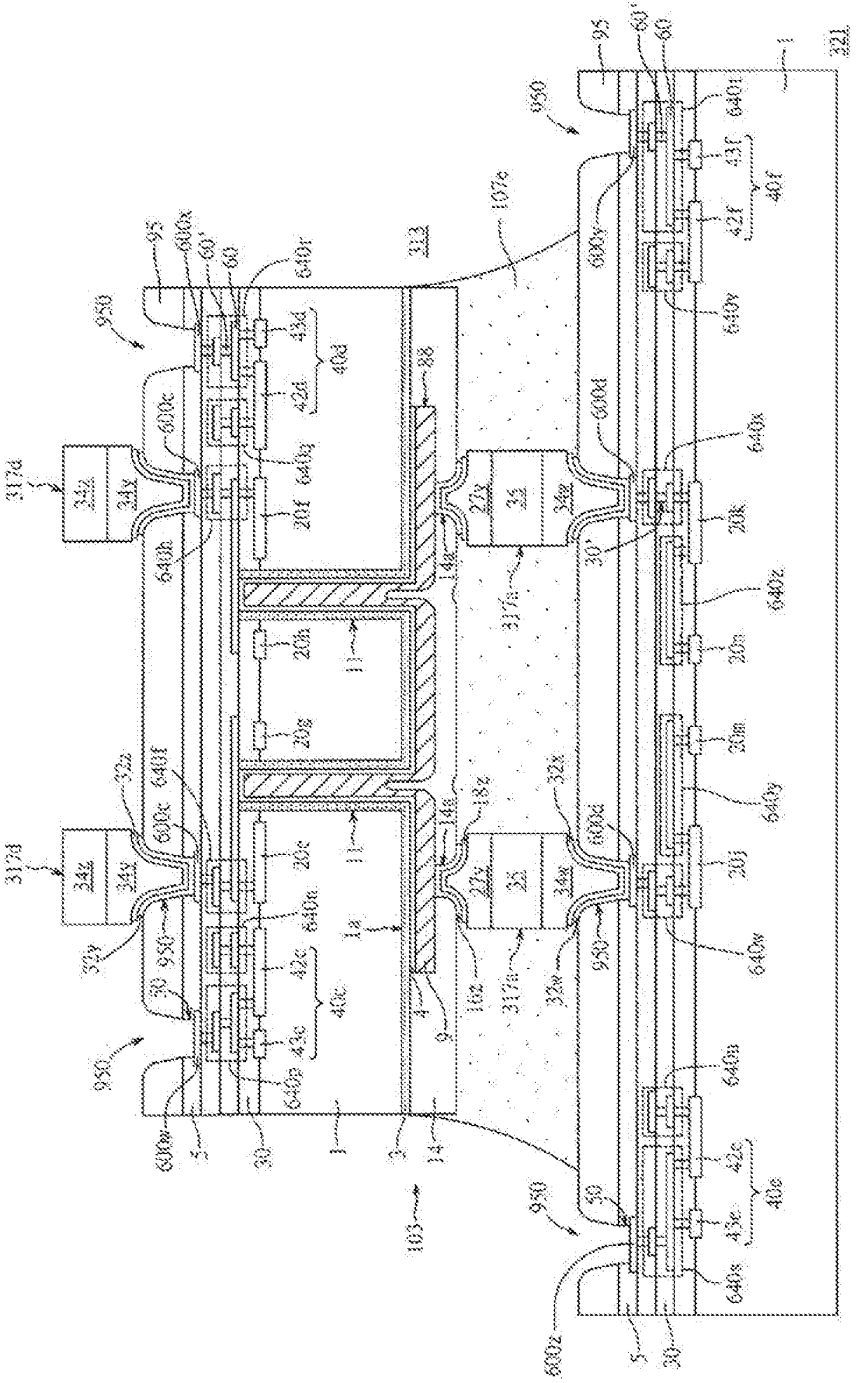

Fig. 44C

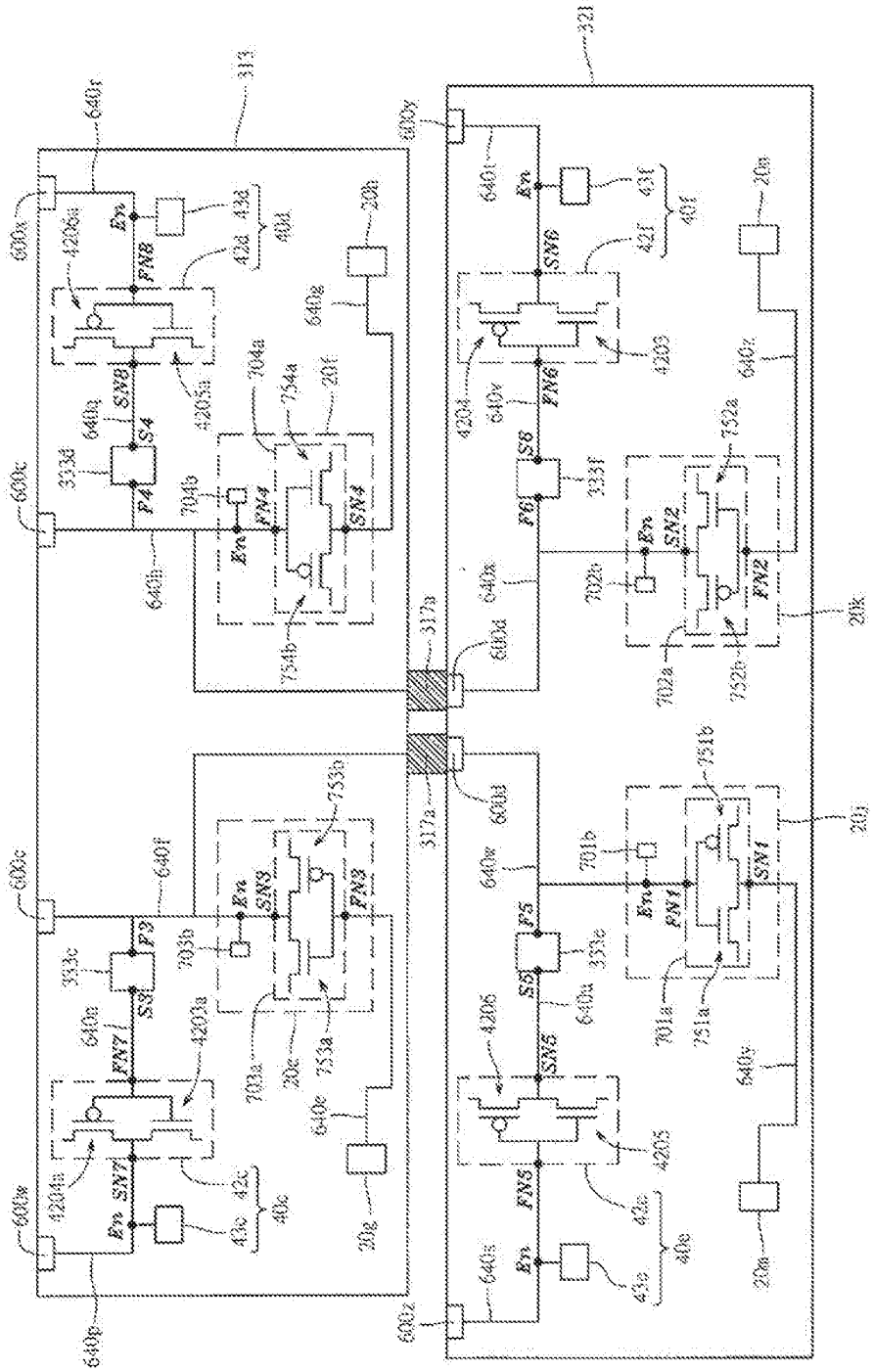

Fig. 45A

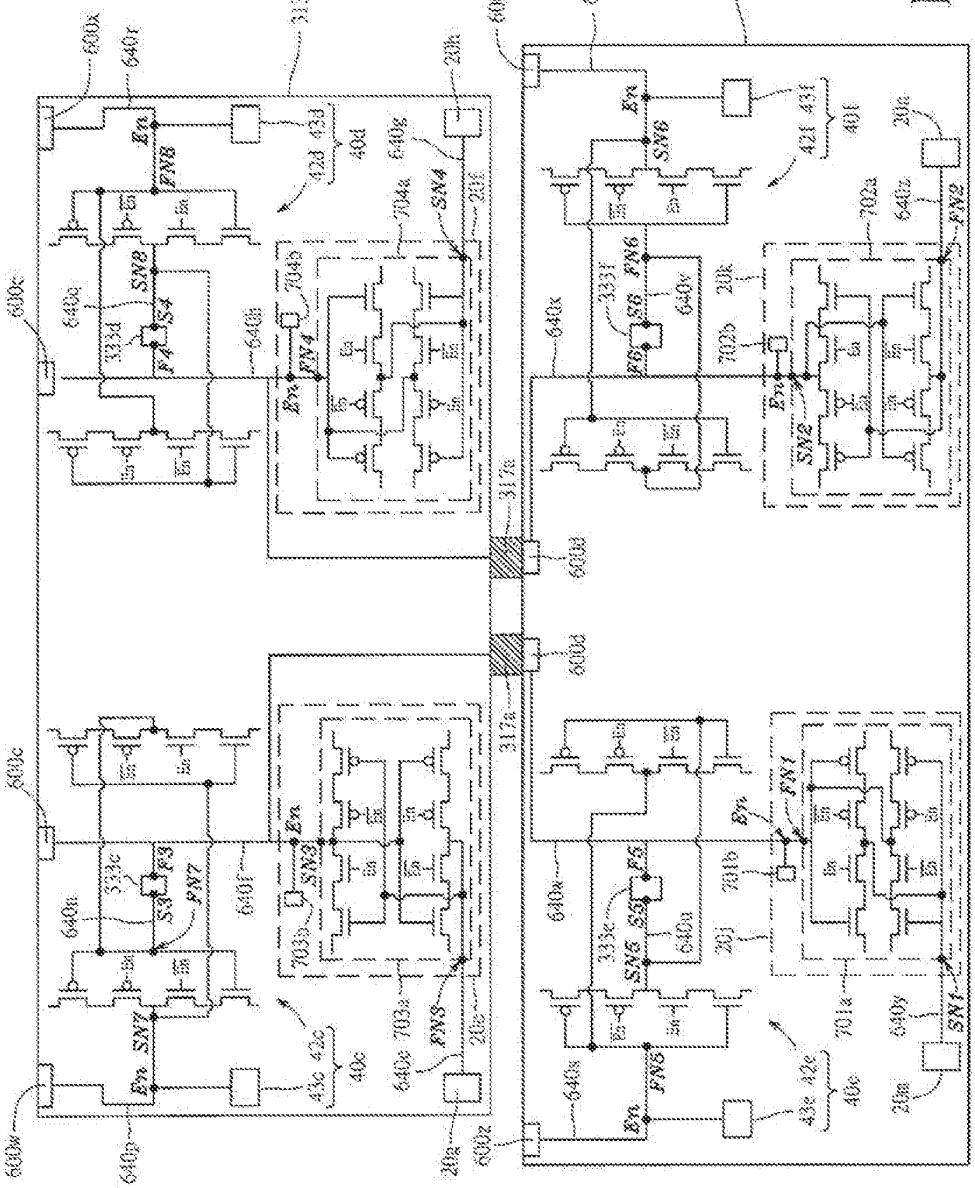

Fig. 45B

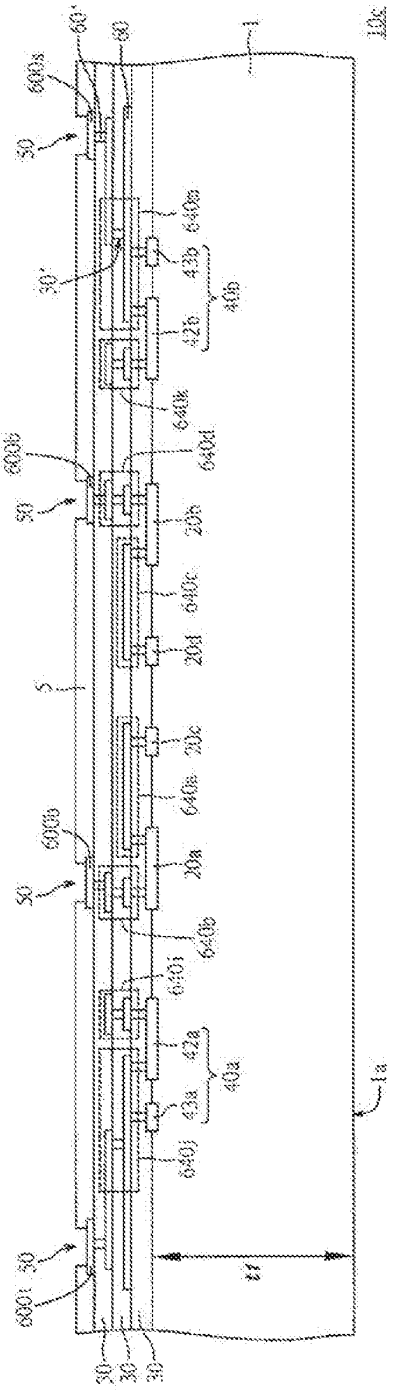

Fig. 46A

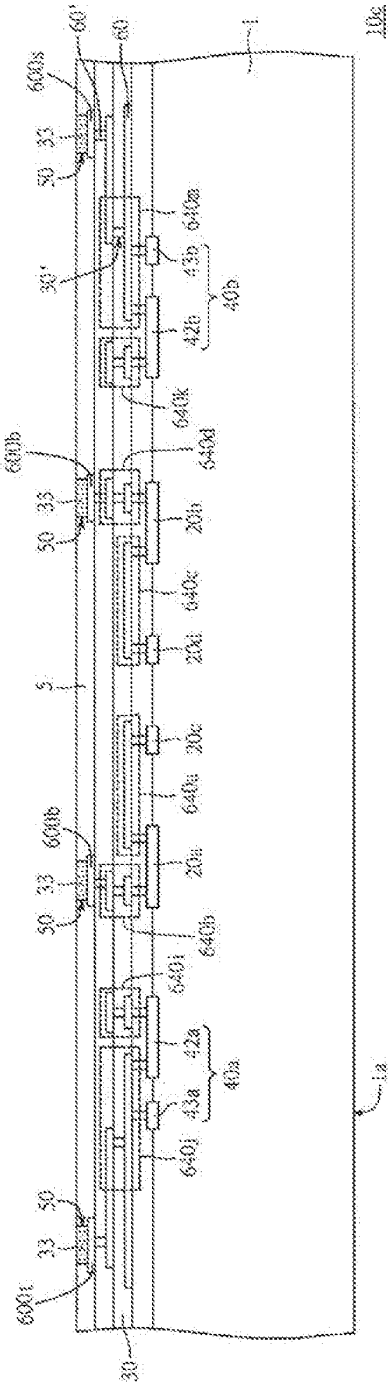

Fig. 46B

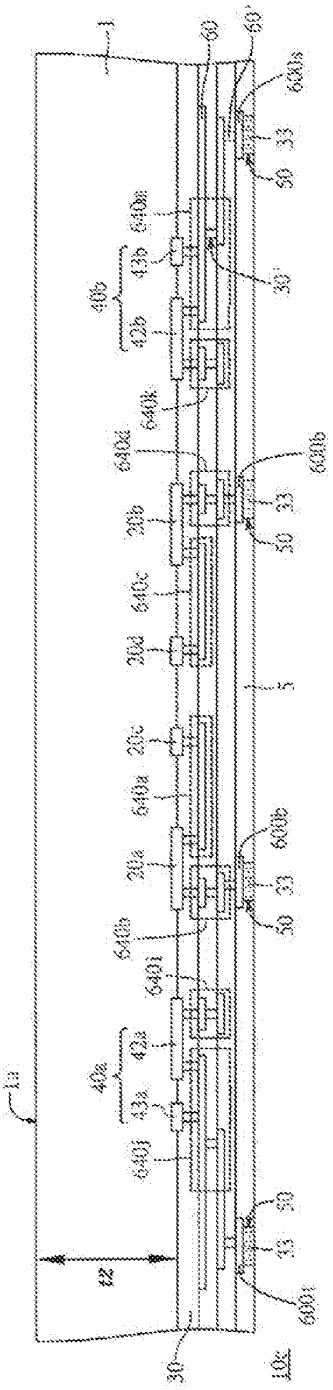

Fig. 46C

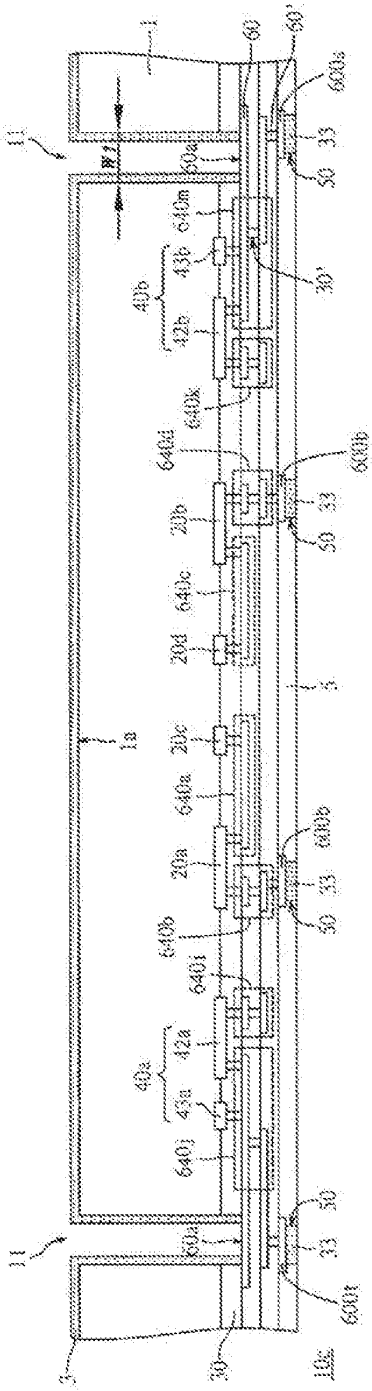

Fig. 46D

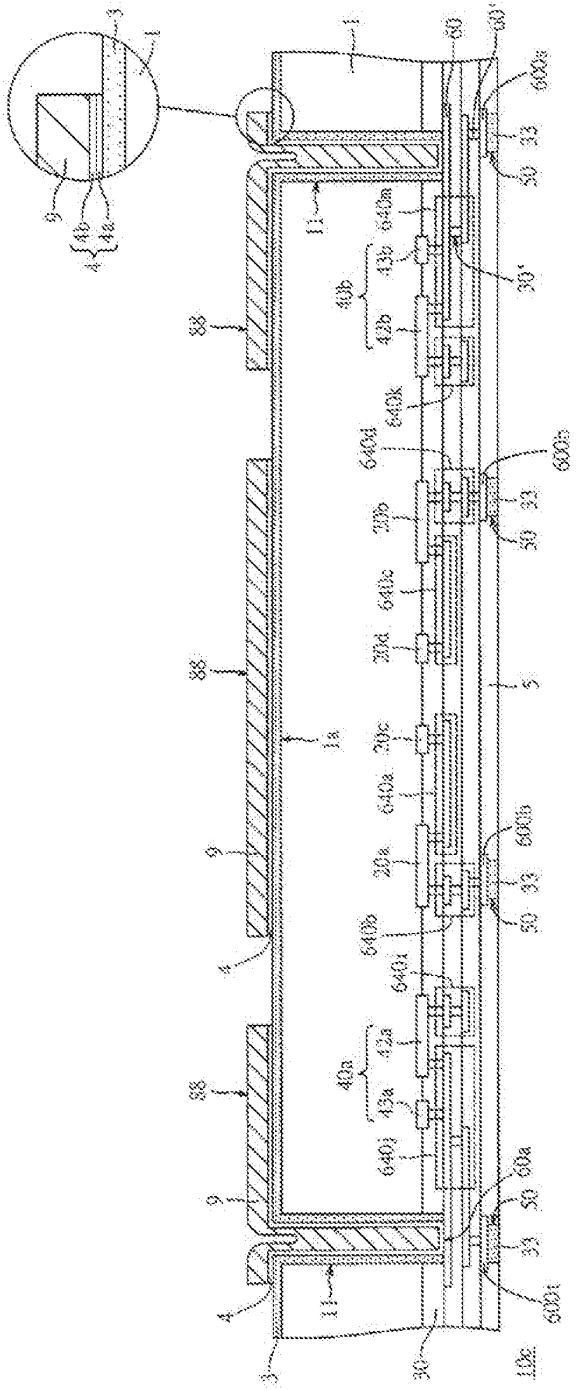

Fig. 46E

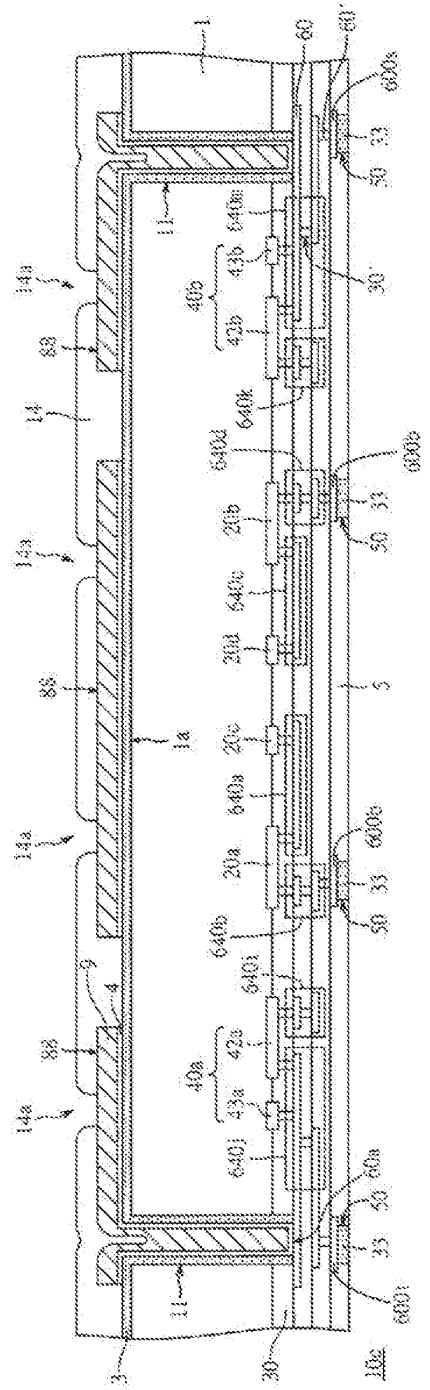

Fig. 46F

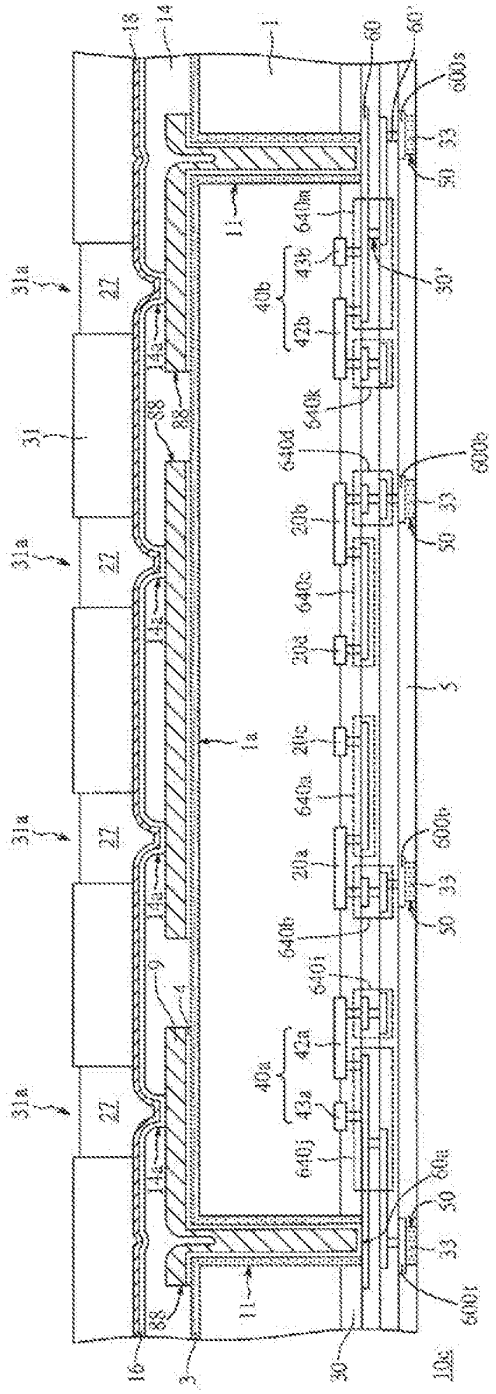

Fig. 46G

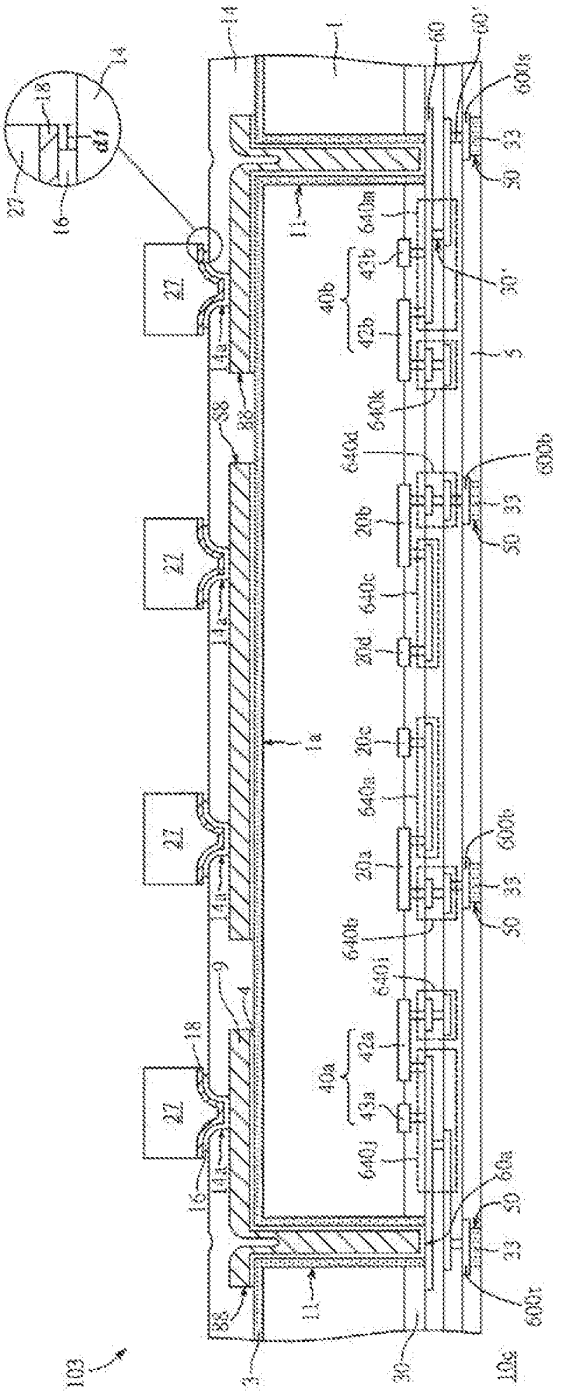

Fig. 46H

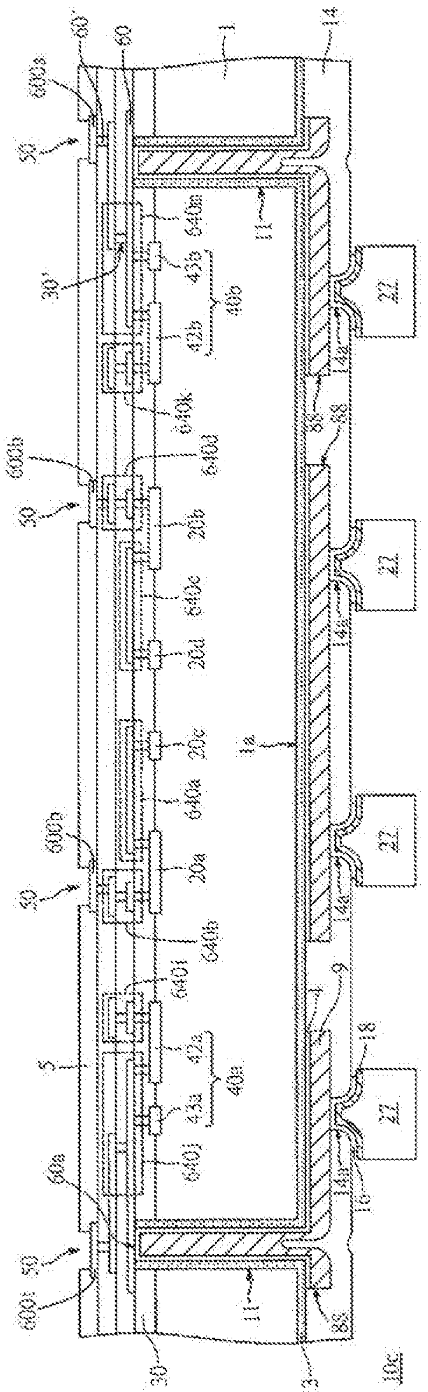
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Fig. 46I

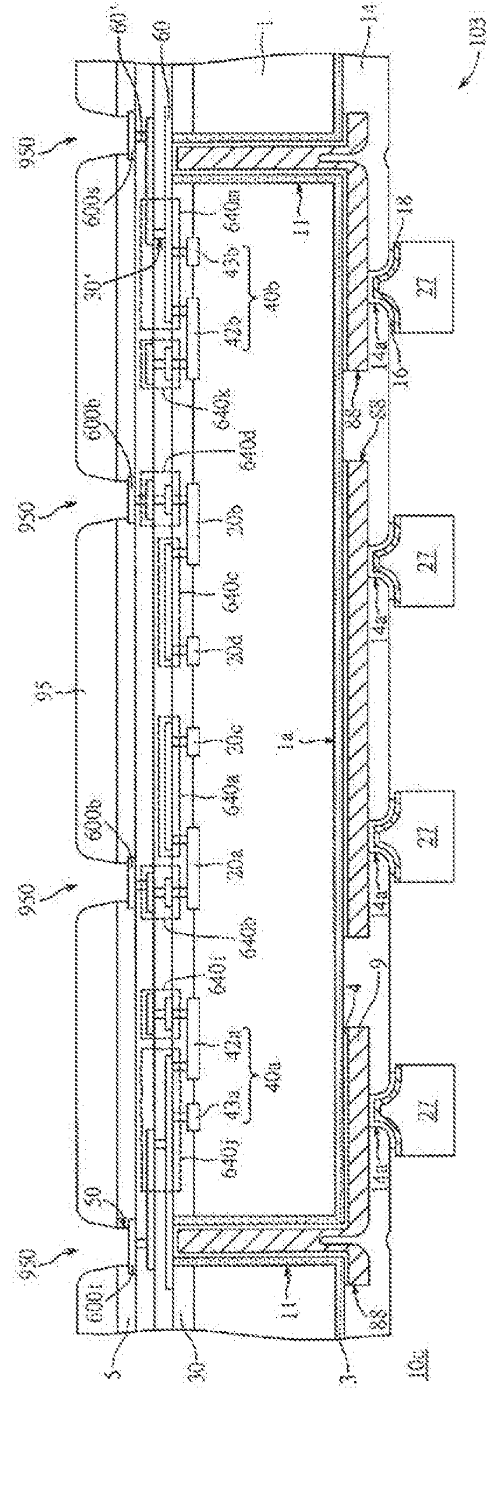

Fig. 46J

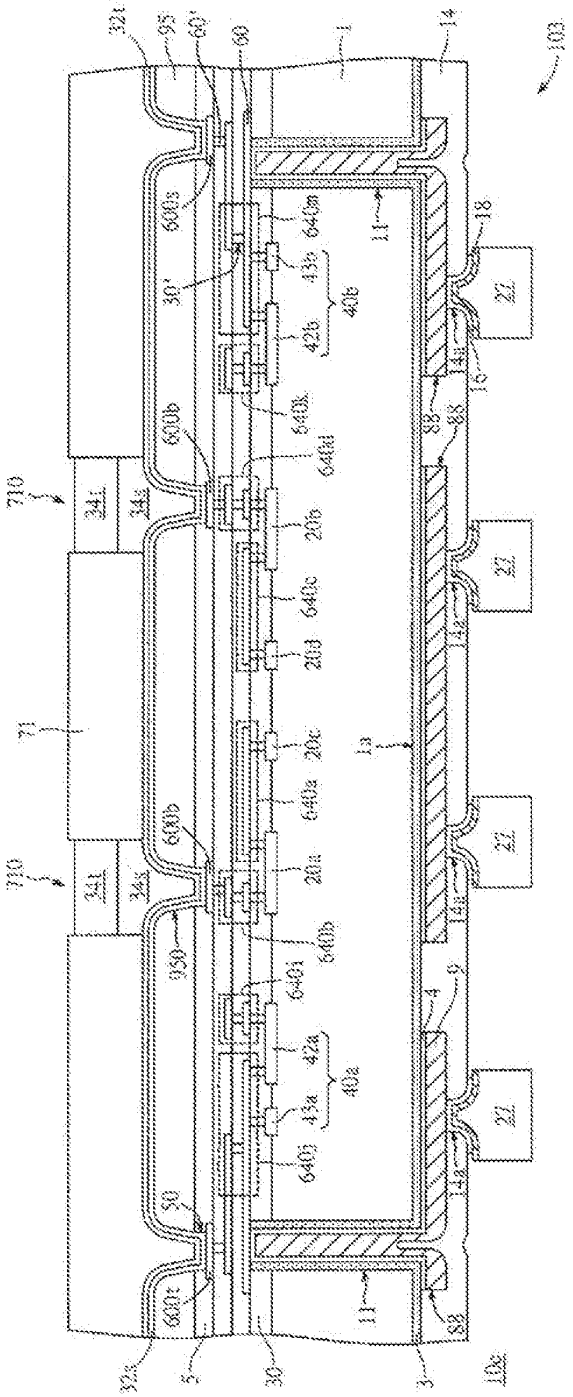

Fig. 46K

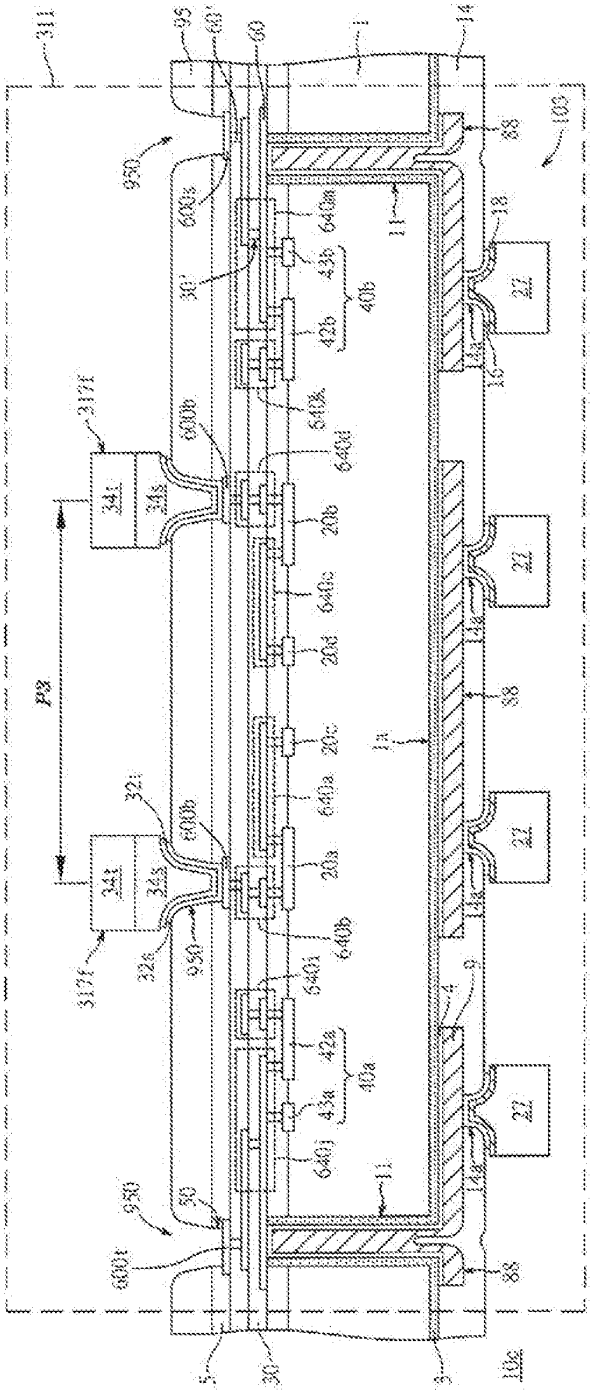

Fig. 46L

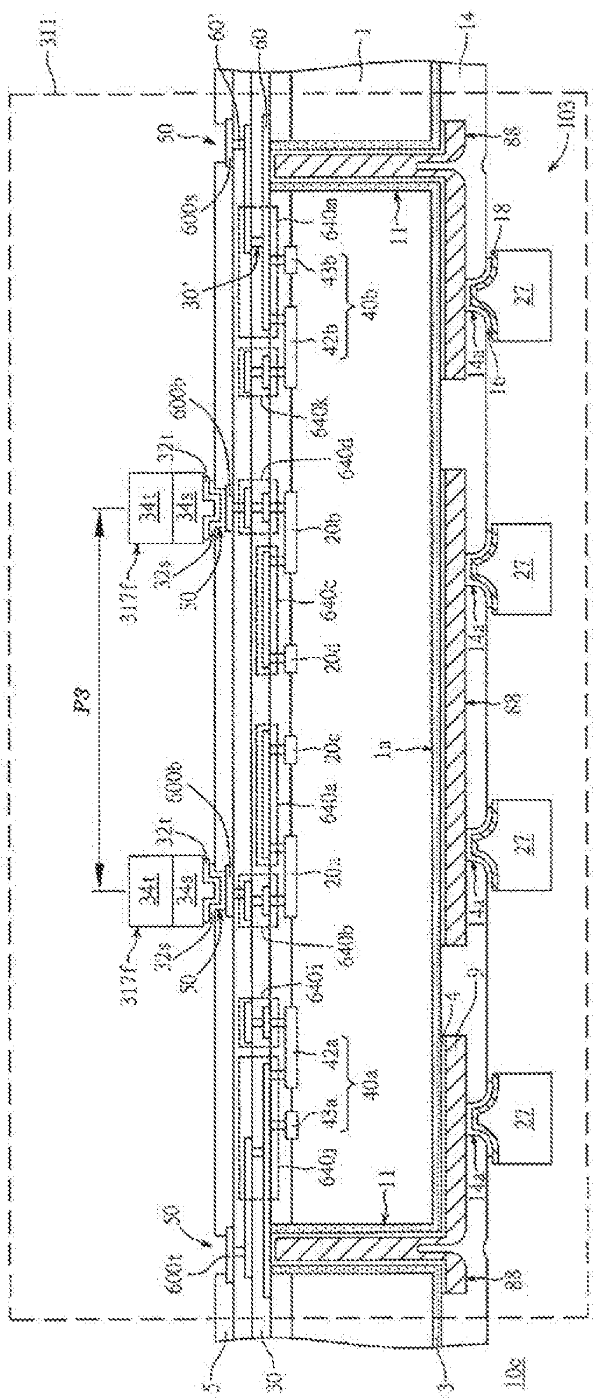

Fig. 46M

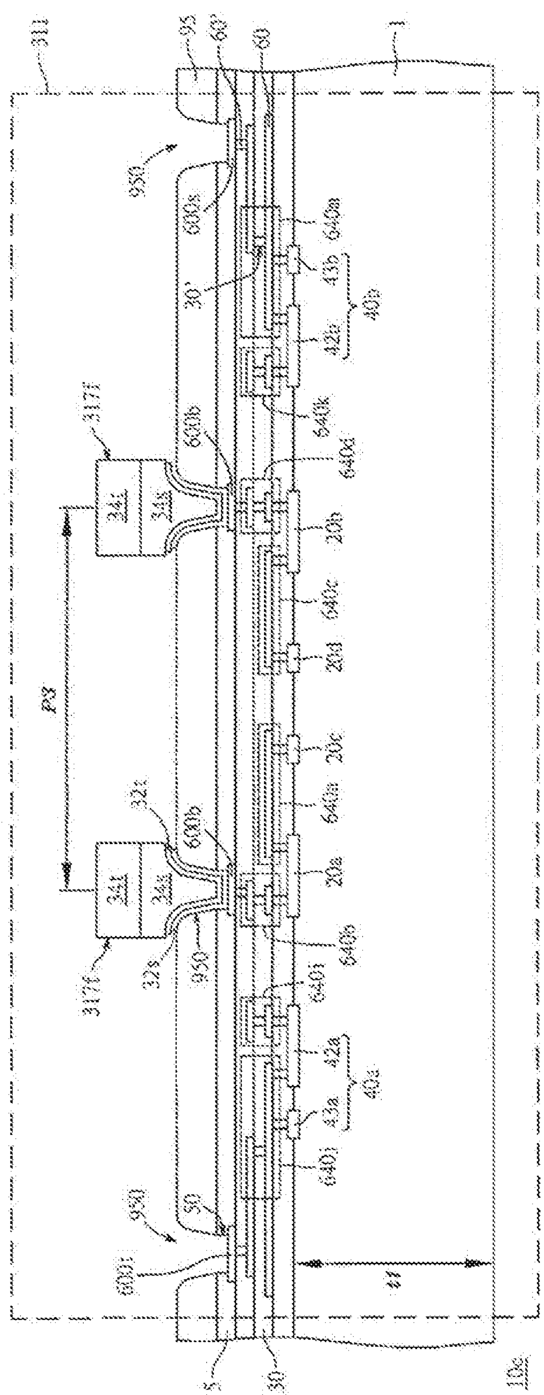
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Fig. 46N

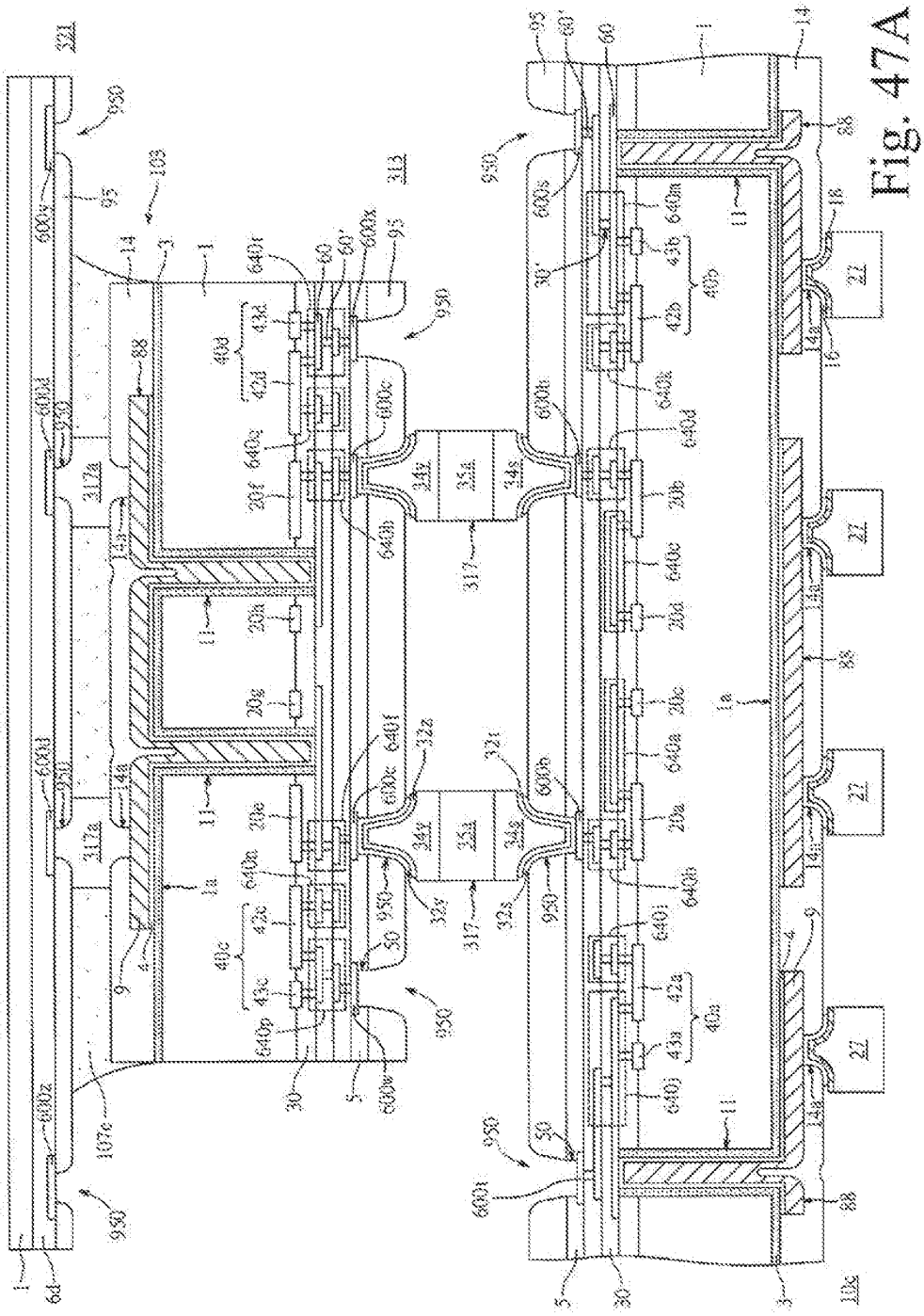

Fig. 47A

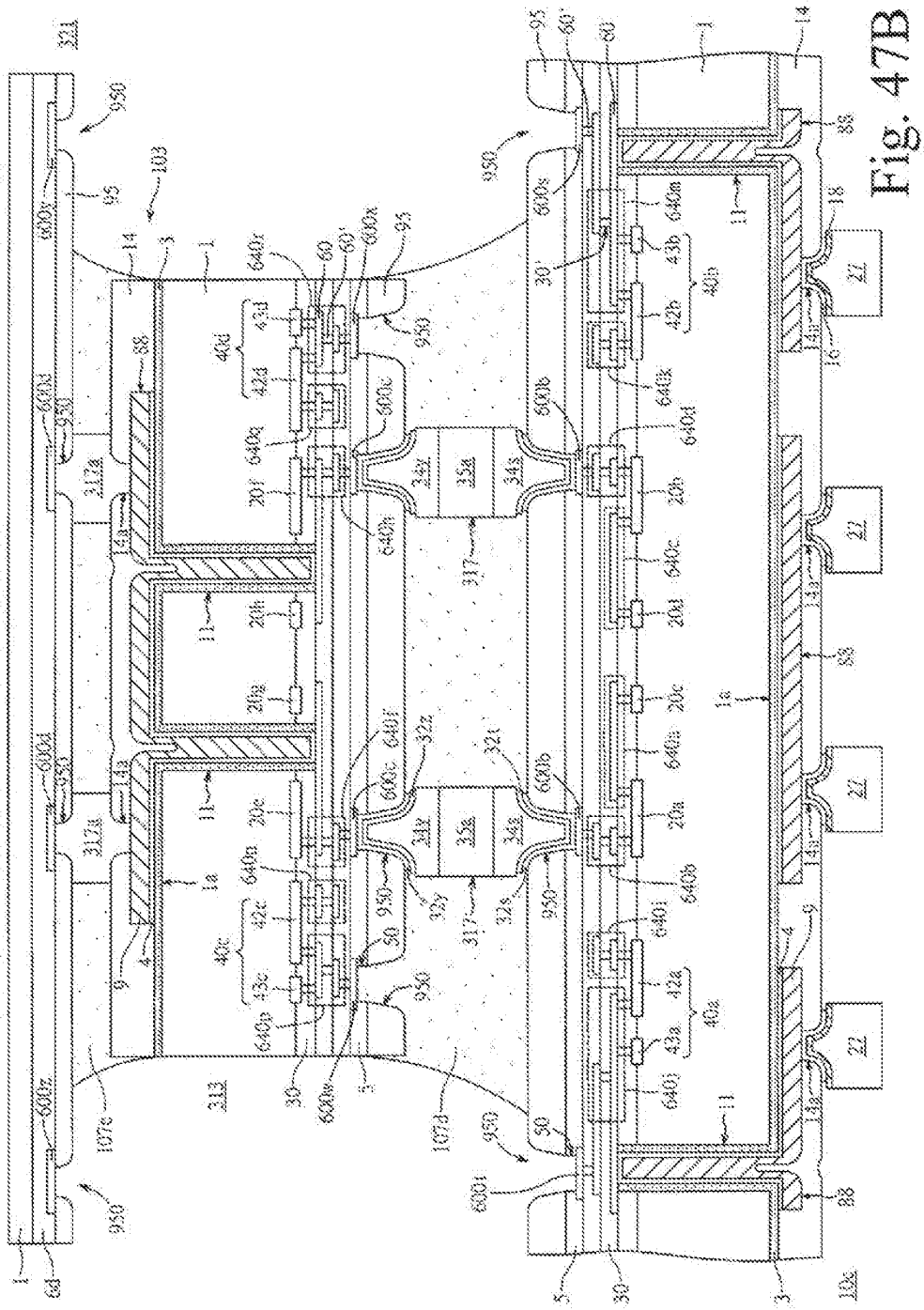

Fig. 47B

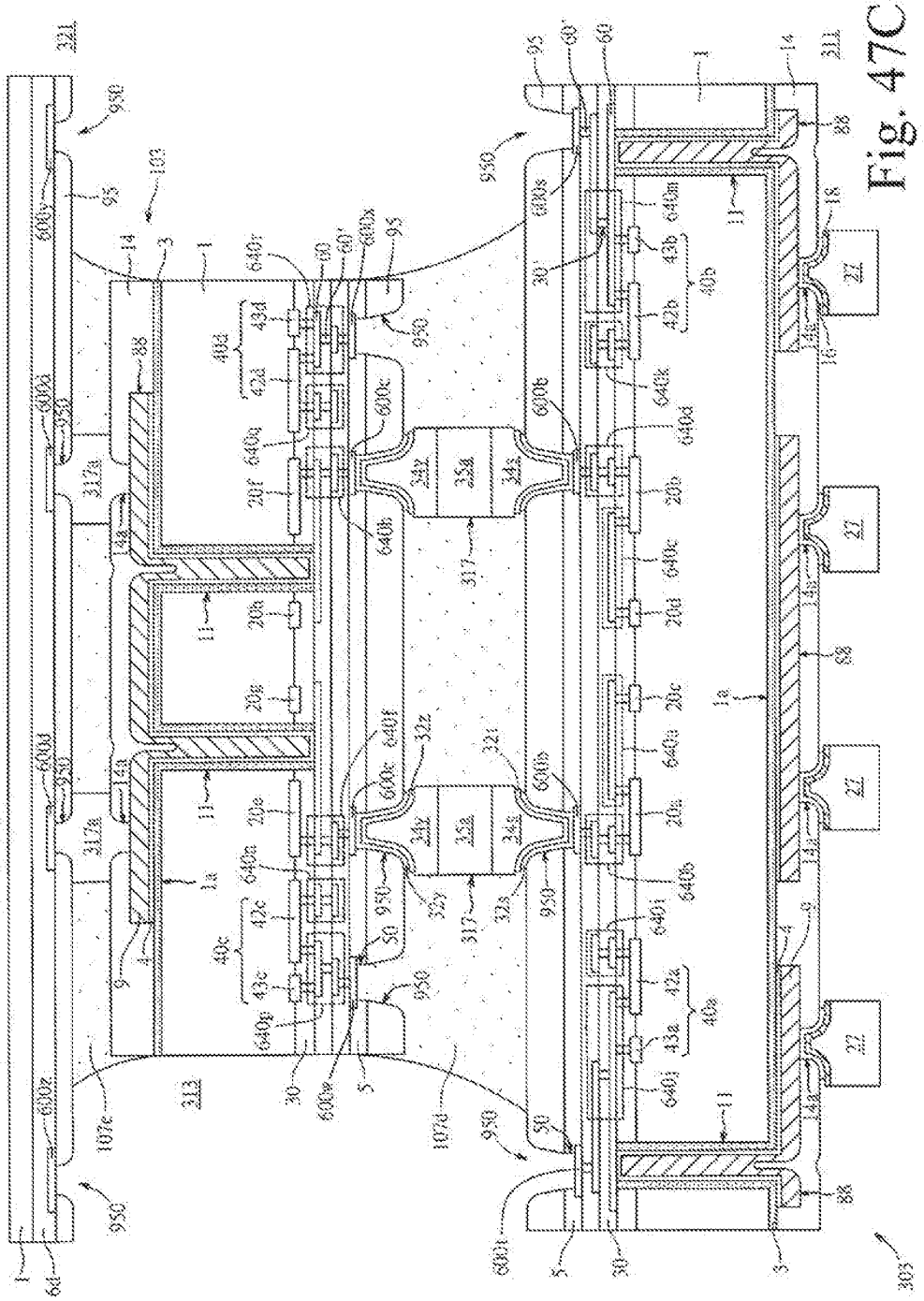

Fig. 47C

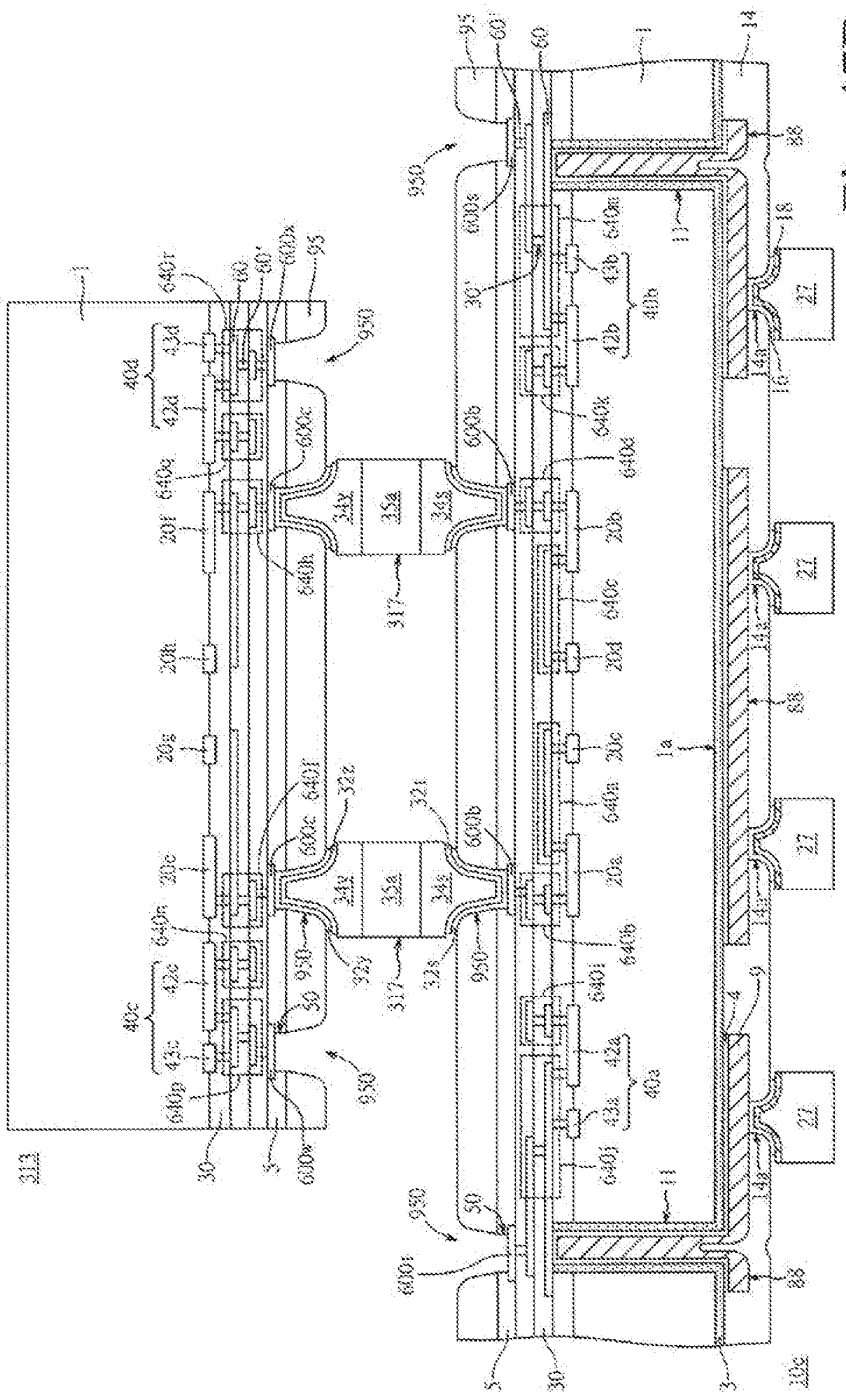

Fig. 47D

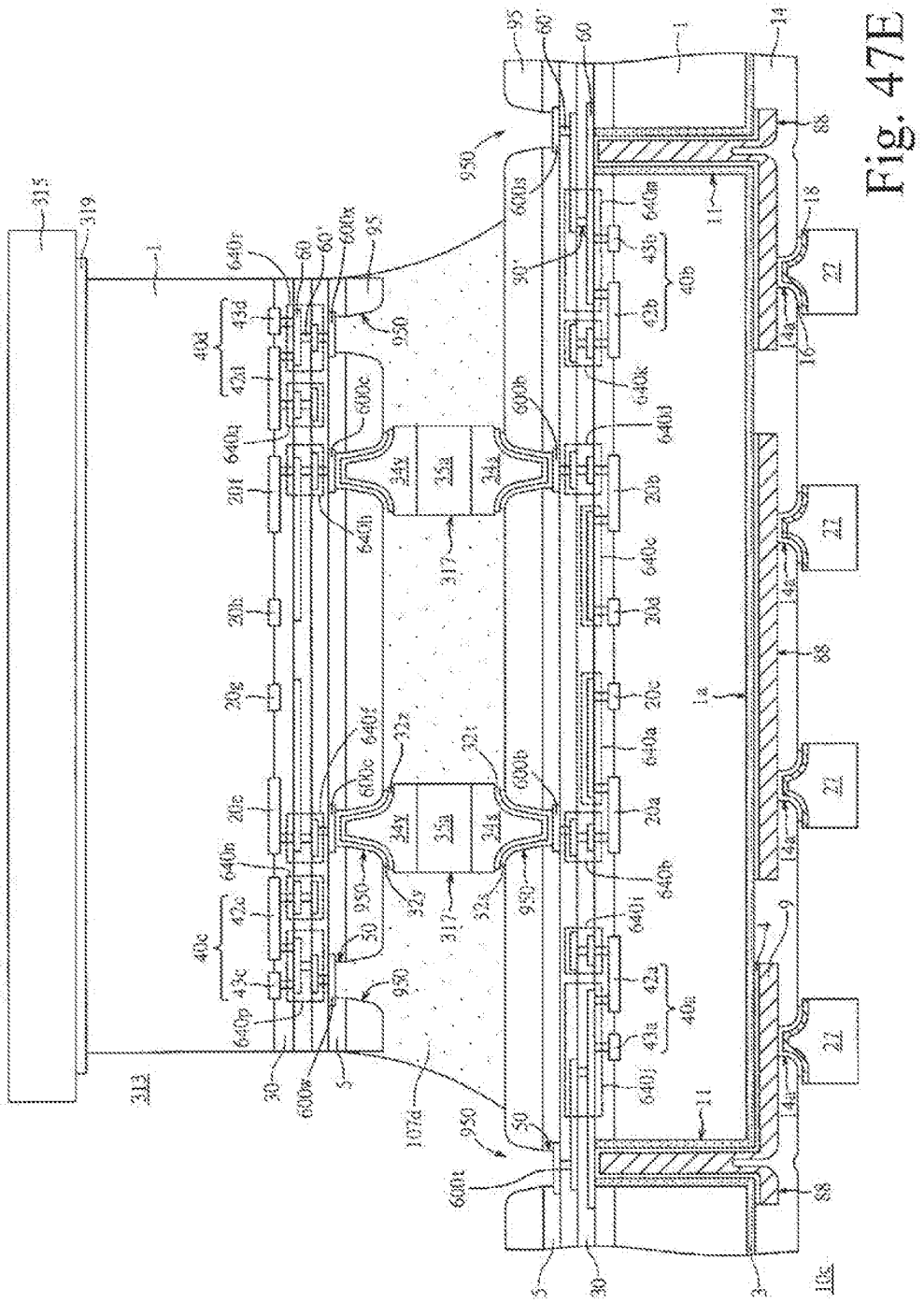

Fig. 47E

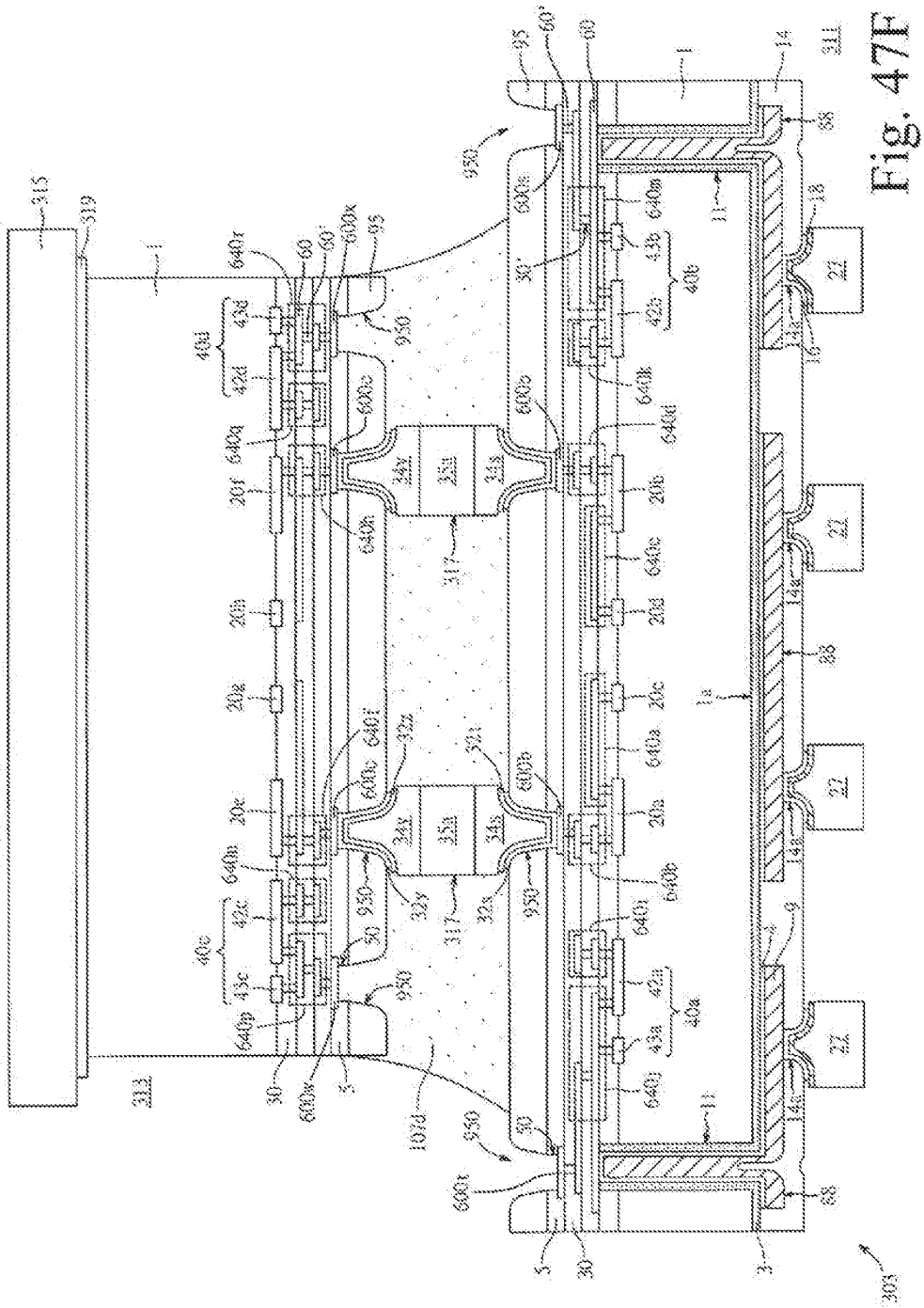

Fig. 47F

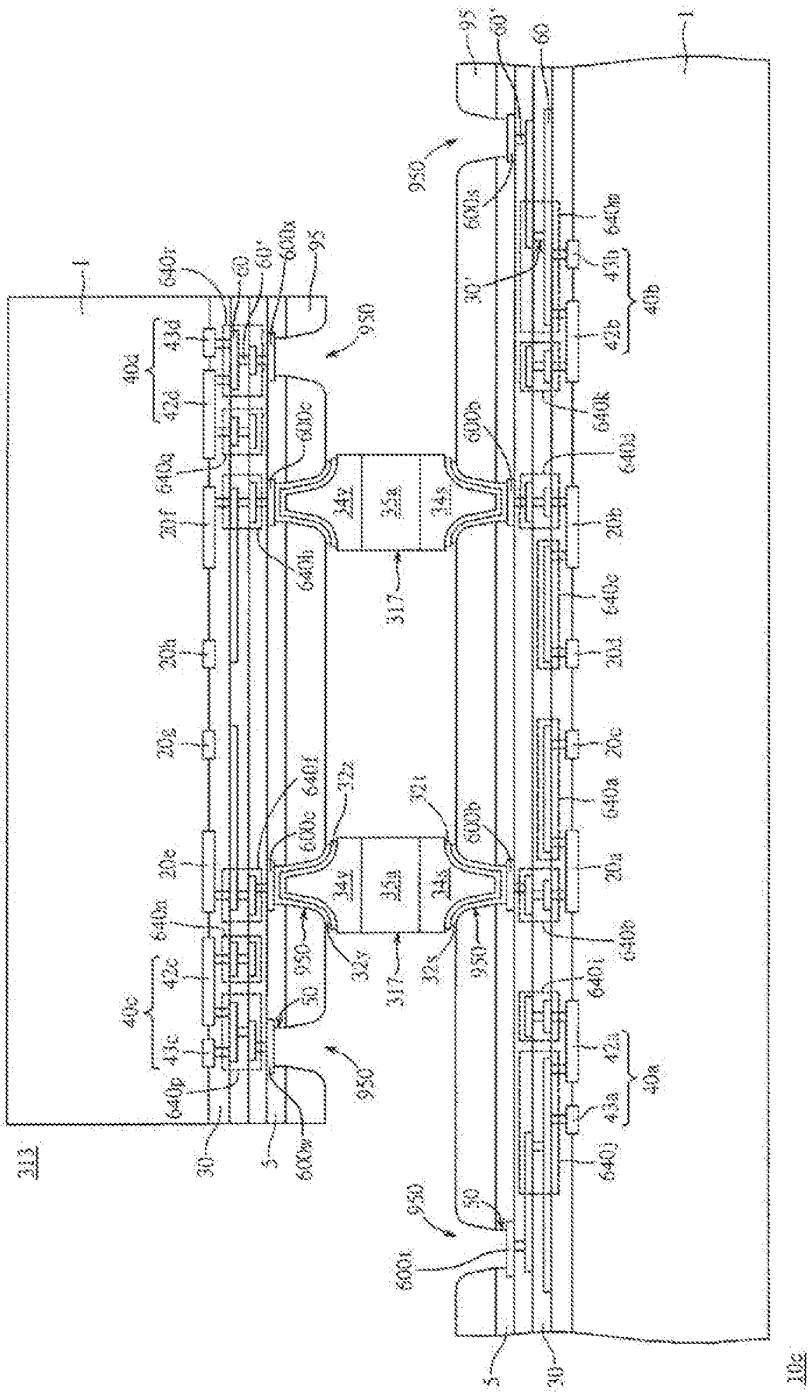

Fig. 47G

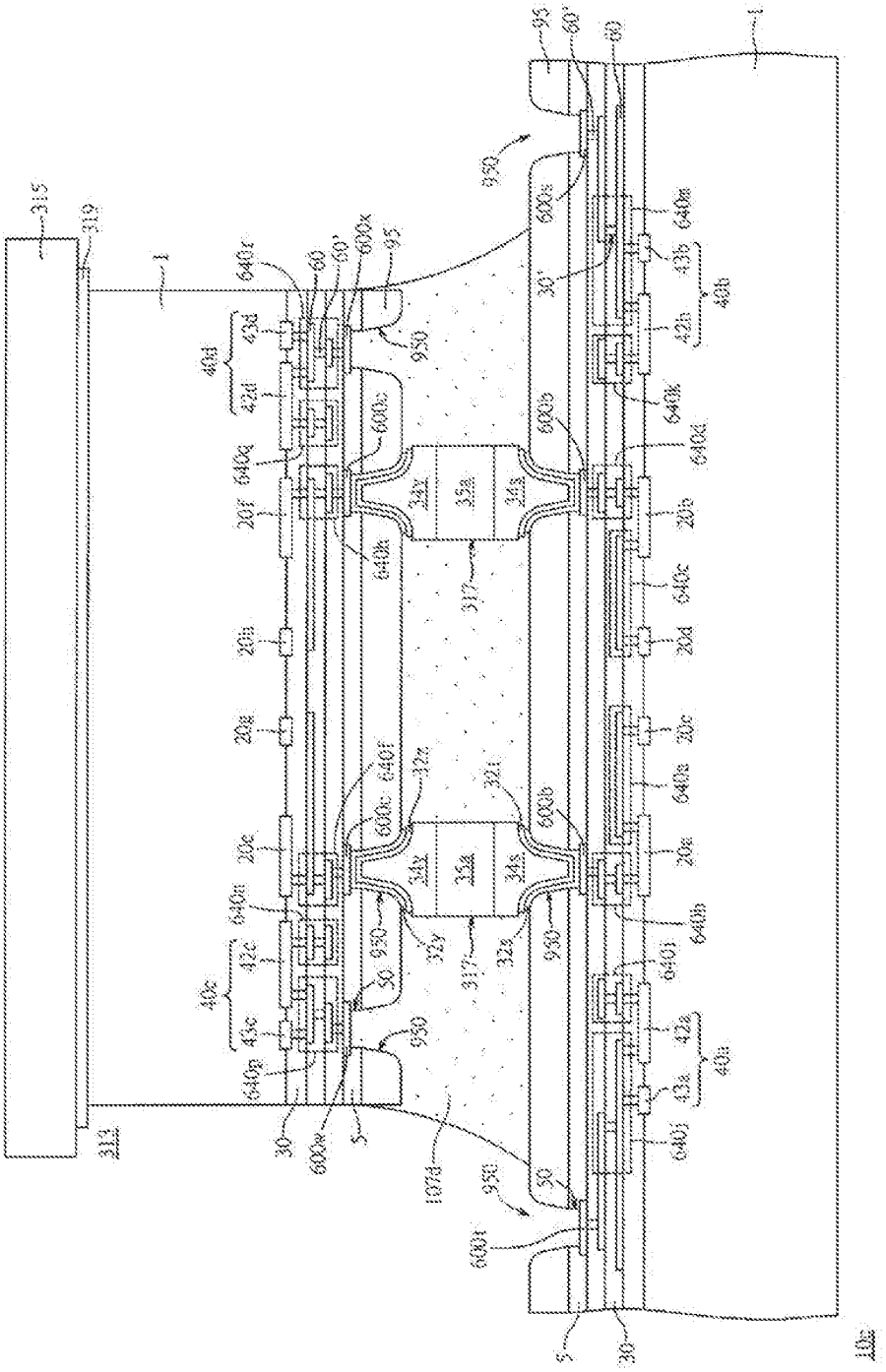

Fig. 47H

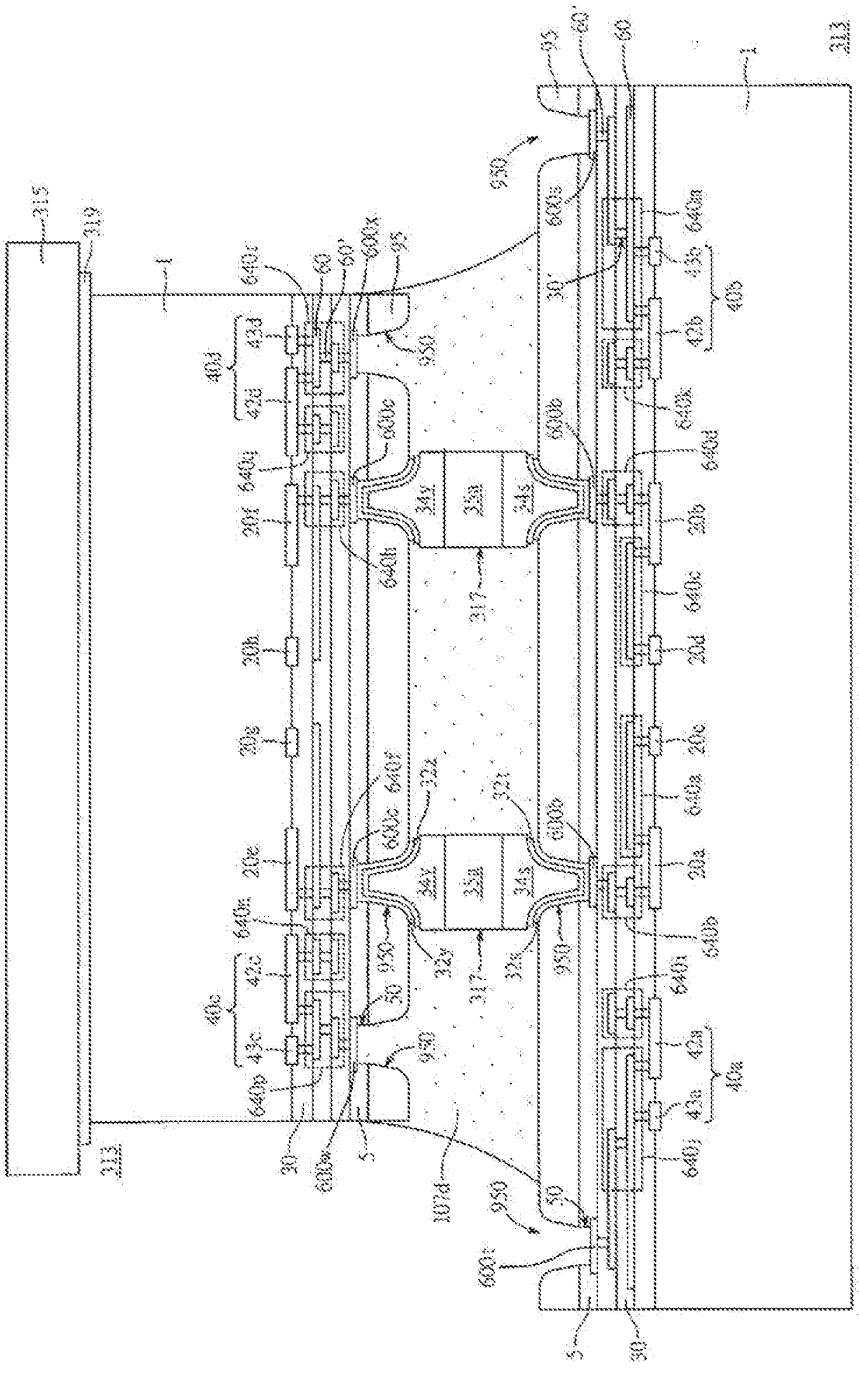

Fig. 47I

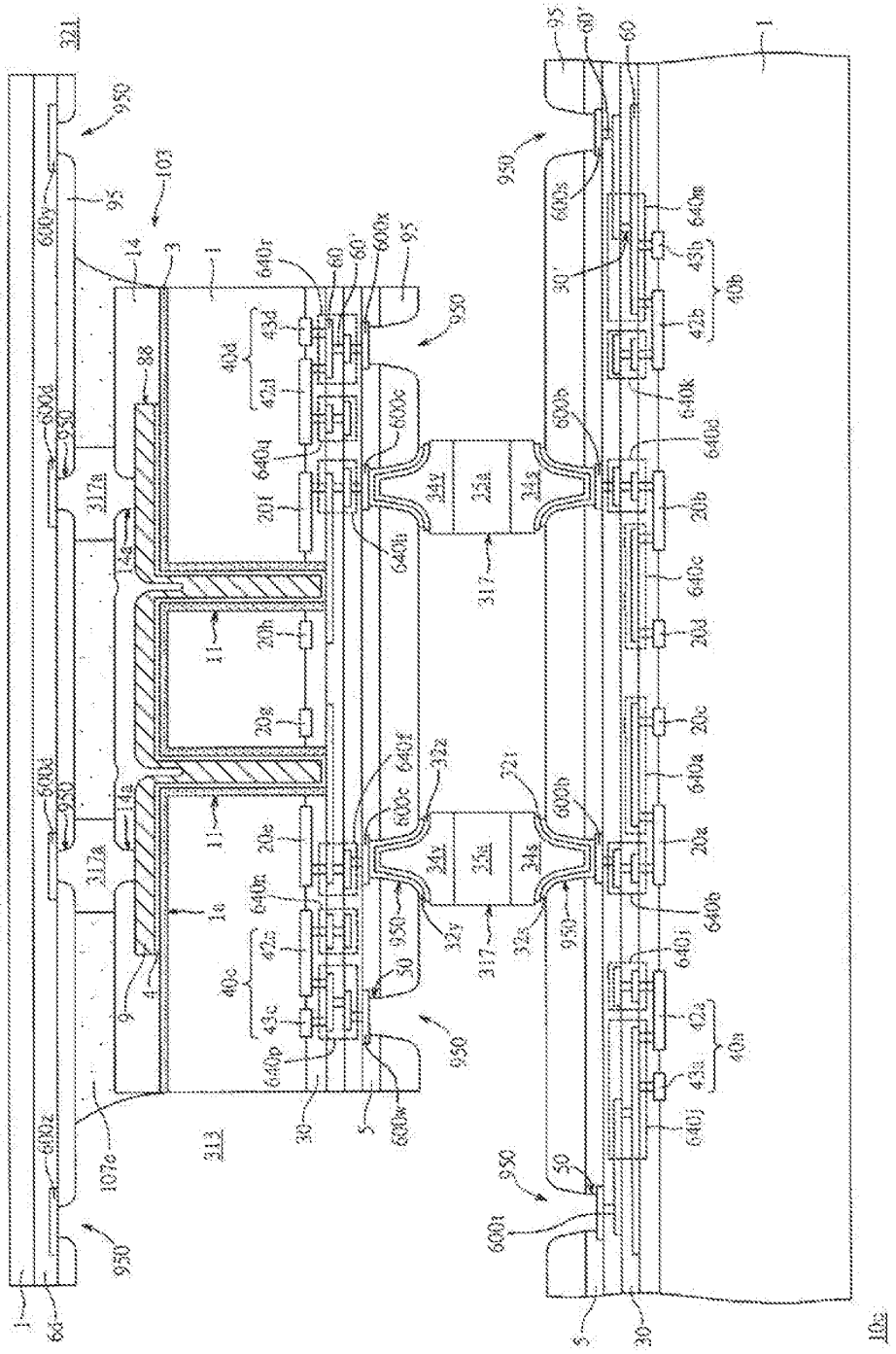

Fig. 47J

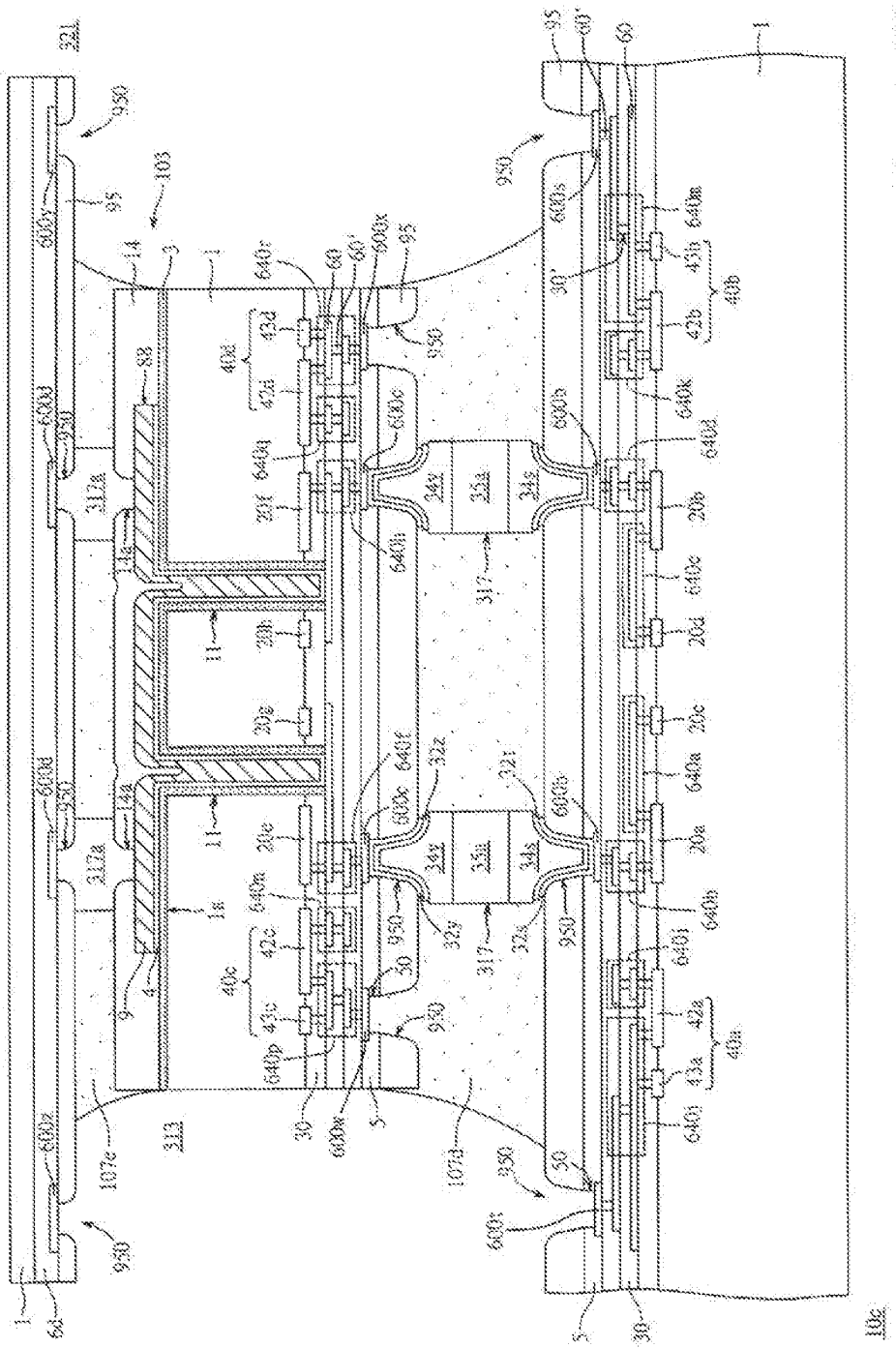

Fig. 47K

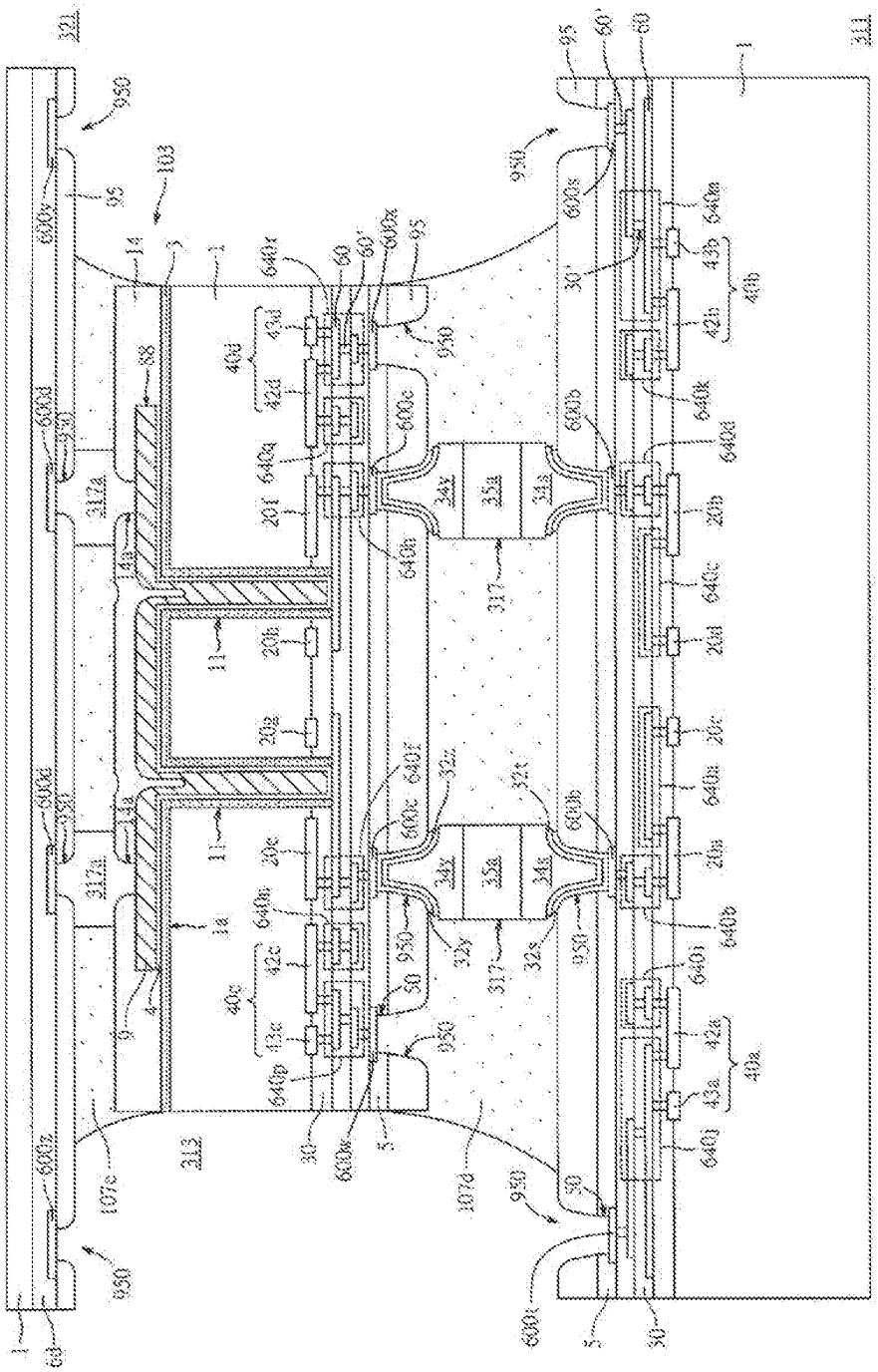

Fig. 47L

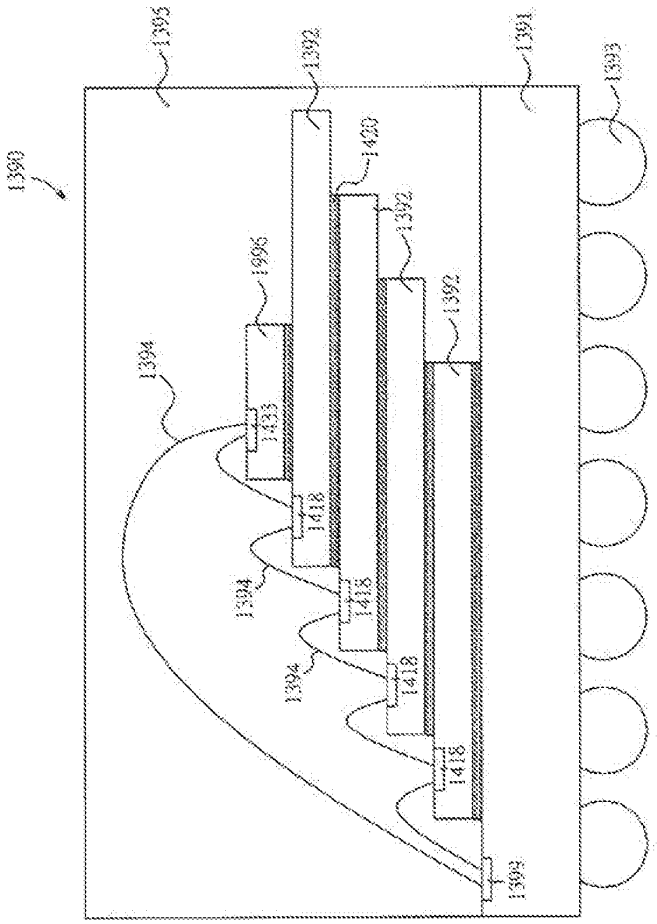
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Fig. 48A

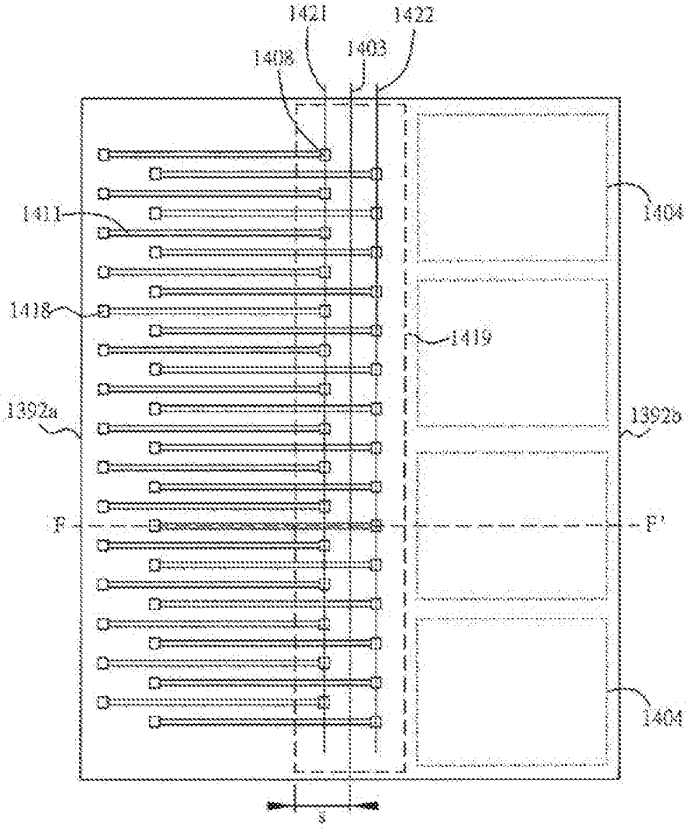

Fig. 48B

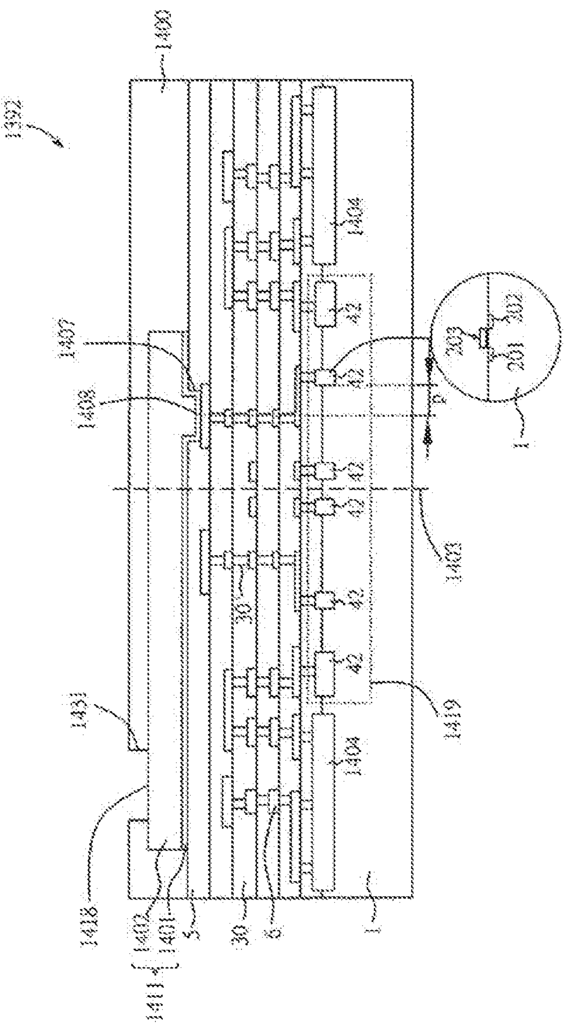
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Fig. 48C

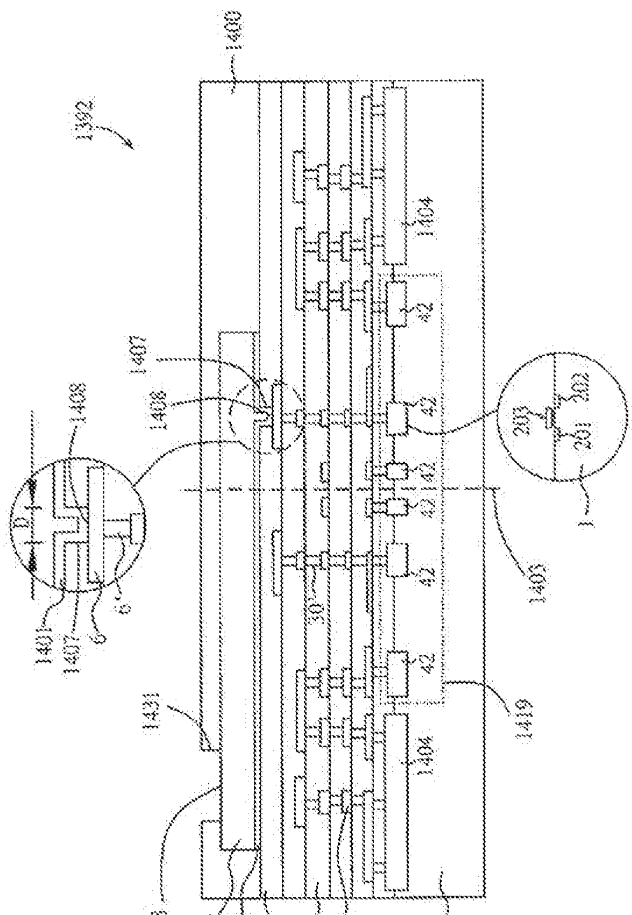
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Fig. 48D

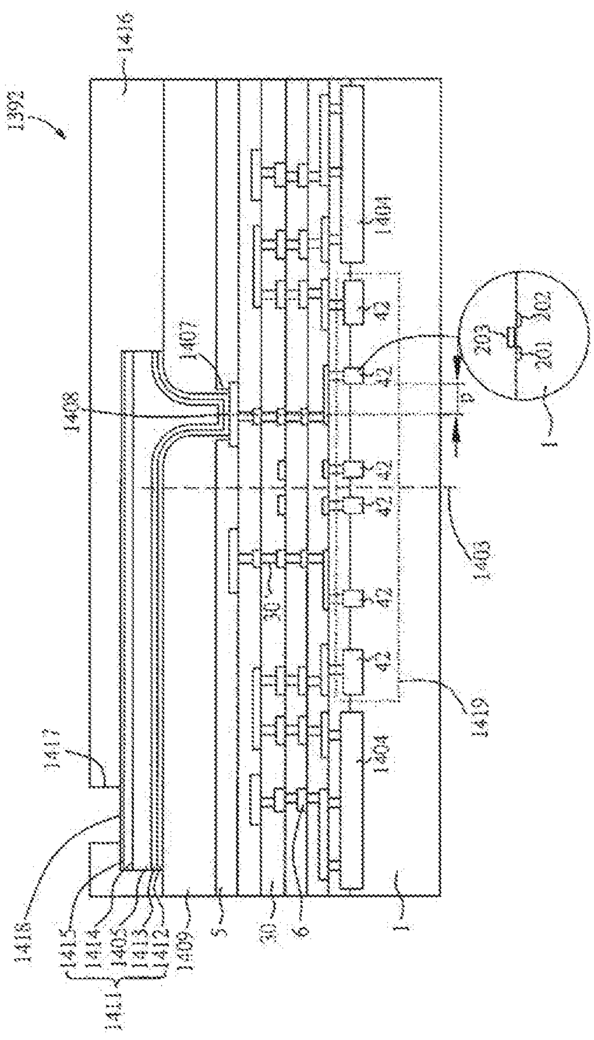
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Fig. 48E

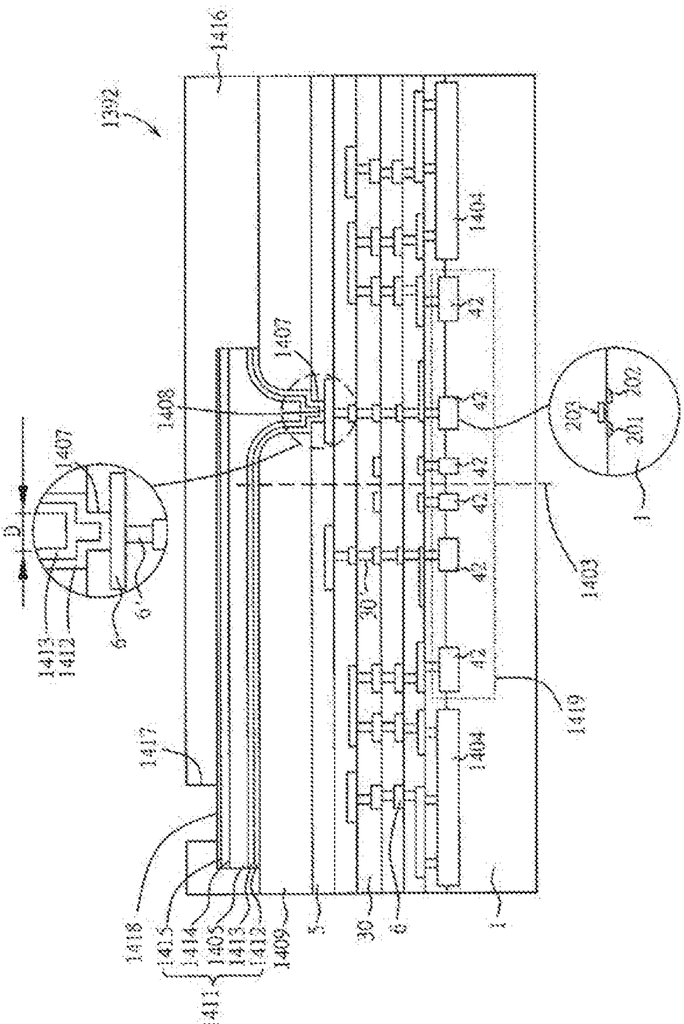
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Fig. 48F

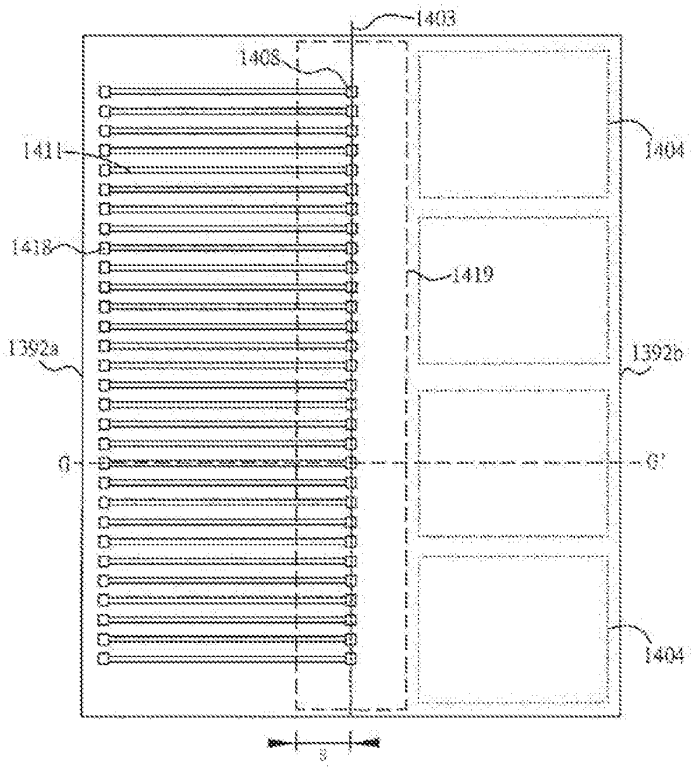

Fig. 48G

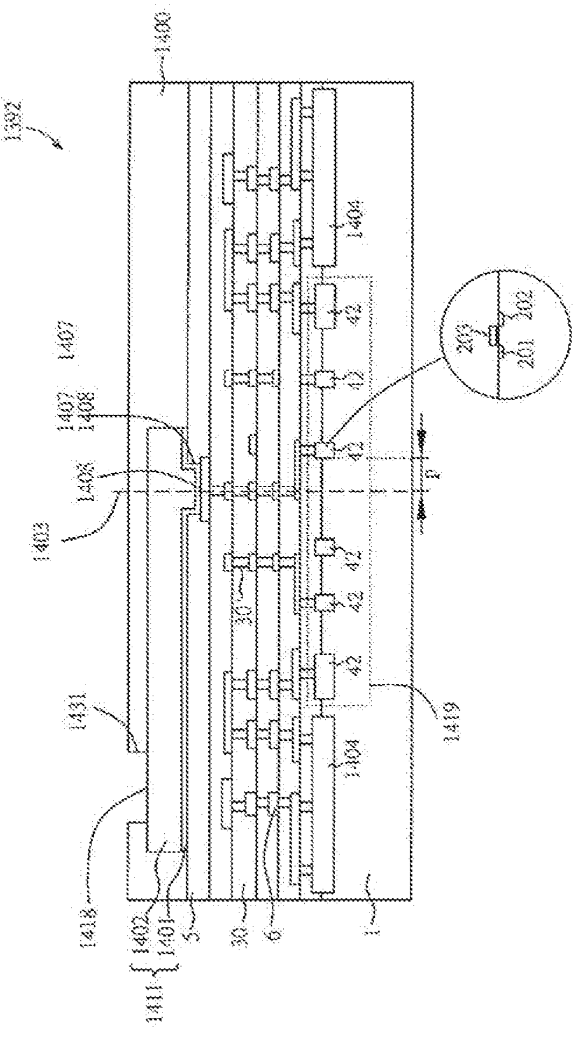
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Fig. 48H

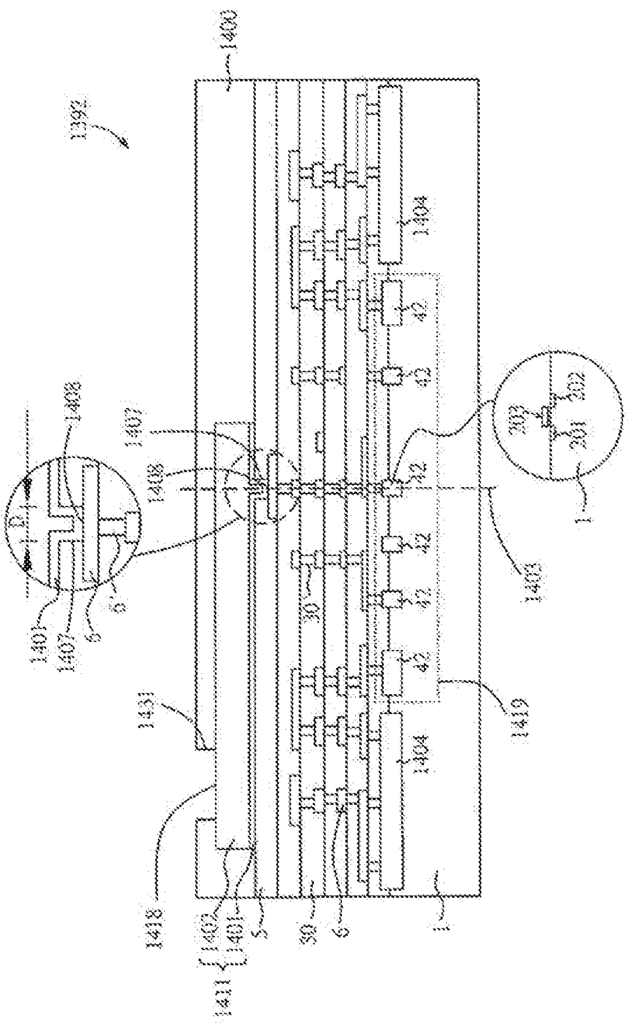
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Fig. 48I

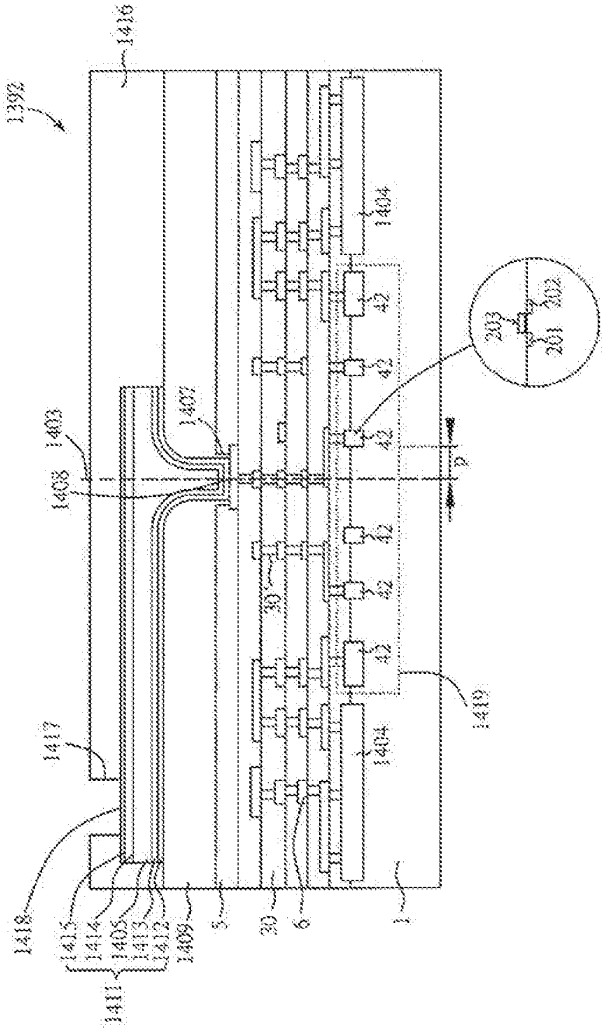
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Fig. 48J

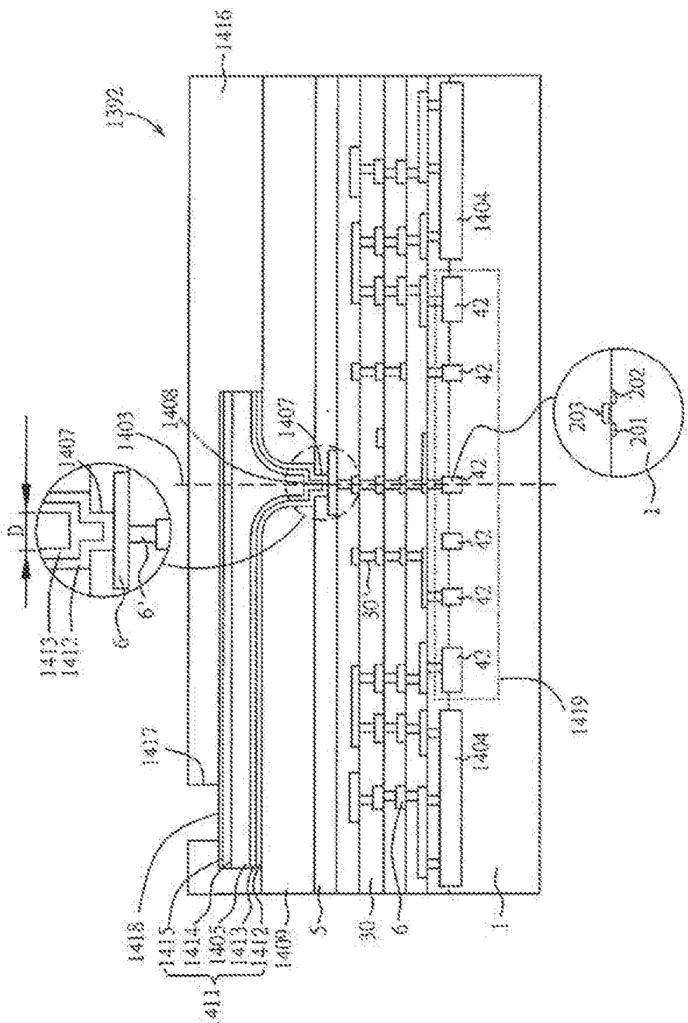
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Fig. 48K

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 10/27056

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G01L 7/00; G06F 19/00 (2010.01)
USPC - 702/50; 702/188
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)
IPC- G01L 7/00; G06F 19/00 (2010.01);
USPC- 702/50; 702/188

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)
PubWest (US Pat, PgPub, EPO, JPO: class, keyword), DialogClassic (Derwent, EPO, JPO, USPTO, WIPO: keyword), GoogleScholar; search terms: microbump, cache, chip, dynamic, random, DRAM, electrostatic, ESD

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2008/0284037 A1 (ANDRY et al.) 20 November 2008 (20.11.2008), Figs. 1-2; para [0003], [0007], [0009], [0027]-[0036], [0041], [0043], [0046], [0048], [0051], [0059]	1-20
Y	US 2005/0046002 A1 (LEE et al.) 03 March 2005 (03.03.2005), para [0030], [0031], [0035], [0036], [0051], [0055]	1-20
Y	WO 2006/011477 A1 (YOSHIDA) 02 February 2006 (02.02.2006), Fig. 4; para [0023], [0061], [0078], [0081]	17-20
A, P	KR 2009 032234 A (LEE et al.) 01 April 2009 (01.04.2009), EPO Abstract	1-20
A	US 2005/0117296 A1 (WU et al.) 02 June 2005 (02.06.2005), entire document	1-20
A	US 6,424,034 B1 (AHN et al.) 23 July 2002 (23.07.2002), entire document	1-20

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 April 2010 (20.04.2010)	10 MAY 2010

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

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United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/182,258	11/06/2018	Ki Min LEE	SUN.LGI.417D3

CONFIRMATION NO. 1026

23557
SALIWANCHIK, LLOYD & EISENSCHENK
A PROFESSIONAL ASSOCIATION
PO Box 142950
GAINESVILLE, FL 32614

PUBLICATION NOTICE

Title: Wireless Power Receiver and Control Method Thereof

Publication No.US-2019-0074727-A1
Publication Date:03/07/2019

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

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Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

I hereby certify that this correspondence is being electronically transmitted via EFS to the United States Patent and Trademark Office on the date shown below:

25 FEBRUARY 2019

Jeff Lloyd, Patent Attorney, Reg. No. 35,589

PRELIMINARY AMENDMENT
Examining Group 2683
Patent Application
Docket No. SUN.LGI.417D3
Serial No. 16/182,258

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit	:	2683
Applicants	:	Ki Min Lee, Jung Oh Lee
Serial No.	:	16/182,258
Filed	:	November 6, 2018
Confirm. No.	:	1026
For	:	Wireless Power Receiver and Control Method Thereof

Mail Stop **Amendment**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

PRELIMINARY AMENDMENT

Sir:

Applicants respectfully request that the patent application identified above be amended as follows:

In the Claims

This listing of claims will replace all prior versions and listings of claims in the application.

1. (Currently Amended) A wireless power receiver, comprising:

a shielding unit;

a first layer on the shielding unit;

a wireless power receiving coil on the first layer;

a second layer on the wireless power receiving coil;

~~a first region disposed between the first layer and the second layer and vertically overlapping the wireless receiving coil; and~~

~~a second region disposed between the first layer and the second layer and not vertically overlapping the wireless receiving coil,~~

a first region in which at least one of the first layer and the second layer overlaps the wireless power receiving coil in a vertical direction perpendicular to an upper surface of the shielding unit; and

a second region in which at least one of the first layer and the second layer does not overlap the wireless power receiving coil in the vertical direction,

wherein a first distance, measured in the vertical direction, between the first layer and the second layer in the first region is greater than a second distance, measured in the vertical direction, between the first layer and the second layer in the second region.

2. (Currently Amended) The wireless power receiver of claim 1, wherein the second distance is smaller than a thickness, measured in the vertical direction, of the wireless power receiving coil.

3-20. (Cancelled)

21. (New) The wireless power receiver of claim 1, wherein a thickness, measured in the vertical direction, of the first layer in the first region is smaller than a thickness, measured in the vertical direction, of the first layer in the second region.

22. (New) The wireless power receiver of claim 21, wherein a thickness, measured in the vertical direction, of the second layer in the first region is smaller than a thickness, measured in the vertical direction, of the second layer in the second region.

23. (New) The wireless power receiver of claim 1, wherein a portion of the first layer is disposed on a side surface of the wireless power receiving coil.

24. (New) The wireless power receiver of claim 23, wherein a portion of the second layer is disposed on the side surface of the wireless power receiving coil.

25. (New) The wireless power receiver of claim 1, comprising: a short range communication antenna on the first layer.

26. (New) The wireless power receiver of claim 25, comprising:

a third region in which at least one of the first layer and the second layer overlaps the short range communication antenna in the vertical direction; and

a fourth region in which at least one of the first layer and the second layer does not overlap the short range communication antenna in the vertical direction,

wherein a third distance, measured in the vertical direction, between the first layer and the second layer in the third region is greater than a fourth distance, measured in the vertical direction, between the first layer and the second layer in the fourth region.

27. (New) The wireless power receiver of claim 26, wherein the fourth distance is smaller than a thickness, measured in the vertical direction, of the short range communication antenna.

28. (New) The wireless power receiver of claim 27, wherein a thickness, measured in the vertical direction, of the first layer in the third region is smaller than a thickness, measured in the vertical direction, of the first layer in the fourth region.

29. (New) The wireless power receiver of claim 26, wherein a thickness, measured in the vertical direction, of the second layer in the third region is smaller than a thickness, measured in the vertical direction, of the second layer in the fourth region.

30. (New) The wireless power receiver of claim 29, wherein a portion of the first layer is disposed on a side surface of the short range communication antenna.

31. (New) The wireless power receiver of claim 26, wherein a portion of the second layer is disposed on the side surface of the short range communication antenna.

32. (New) The wireless power receiver of claim 1, comprising: an adhesive between the shielding unit and the first layer.

33. (New) The wireless power receiver of claim 1, wherein the shielding unit has a reception space in a predetermined area.

34. (New) The wireless power receiver of claim 1, wherein the second region is positioned at an outer side of the wireless power receiving coil.

35. (New) A wireless power receiver, comprising:

a shielding unit;

a first layer on the shielding unit;

a first wireless power receiving coil on the first layer;

a second layer on the first wireless power receiving coil;

a second wireless power receiving coil on the second layer;

a third layer on the second wireless power receiving coil;

a first region in which the second layer overlaps the first wireless power receiving coil and the second wireless power receiving coil in a vertical direction perpendicular to an upper surface of the shielding unit; and

a second region in which the second layer does not vertically overlap the first wireless power receiving coil or the second wireless power receiving coil in the vertical direction;

wherein at least one of the following two conditions is met:

i) a first distance, measured in the vertical direction, between the first layer and the second layer in the first region is greater than a second distance, measured in the vertical direction, between the first layer and the second layer in the second region; and

ii) a third distance, measured in the vertical direction, between the second layer and the third layer in the first region is greater than a fourth distance, measured in the vertical direction, between the second layer and the third layer in the second region.

36. (New) The wireless power receiver of claim 35, wherein the second region is positioned at an outer side of the first wireless power receiving coil, at an outer side of the second wireless power receiving coil, or both.

37. (New) A wireless power receiver, comprising:

a shielding unit;

a first layer on the shielding unit;

a wireless power receiving coil on the first layer;

a second layer on the wireless power receiving coil;

a first region in which at least one of the first layer and the second layer overlaps the wireless power receiving coil in a vertical direction perpendicular to an upper surface of the shielding unit; and

a second region in which at least one of the first layer and the second layer does not overlap the wireless power receiving coil in the vertical direction,

wherein a first gap between the first layer and the second layer in the first region is larger than a second gap between the first layer and the second layer in the second region.

38. (New) The wireless power receiver of claim 37, wherein the second gap is smaller than a thickness, measured in the vertical direction, of the wireless power receiving coil.

Remarks

By this Preliminary Amendment, the specification has been amended to add PCT priority information. Prior to examination, claims 1 and 2 are amended, claims 3-20 are canceled, and claims 21-38 are added. No new matter is added.

The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16, 1.17, and 1.492 as required by this paper to Deposit Account No. 19-0065.

Respectfully submitted,

Jeff Lloyd
Patent Attorney
Registration No. 35,589
Phone No.: 352-375-8100
Fax No.: 352-372-5800
Address: Saliwanchik, Lloyd & Eisenschenk
A Professional Association
P.O. Box 142950
Gainesville, FL 32614-2950

JL/lem

J:\SUN\LGI\417D3\Amd-Resp\PreAmd.doc/lem

Electronic Acknowledgement Receipt

EFS ID:	35243793
Application Number:	16182258
International Application Number:	
Confirmation Number:	1026
Title of Invention:	Wireless Power Receiver and Control Method Thereof
First Named Inventor/Applicant Name:	Ki Min LEE
Customer Number:	23557
Filer:	Jeff Lloyd/Larann Massey
Filer Authorized By:	Jeff Lloyd
Attorney Docket Number:	SUN.LGI.417D3
Receipt Date:	25-FEB-2019
Filing Date:	06-NOV-2018
Time Stamp:	16:55:00
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		SUN-LGI-417D3-PreAmd.pdf	321978 d9186dbad173d3ad3cec706d631163f20635d3a8	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	1
	Claims	2	5
	Applicant Arguments/Remarks Made in an Amendment	6	6
Warnings:			
Information:			
	Total Files Size (in bytes):	321978	

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/182,258	Filing Date 11/06/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	02/25/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/SHARAIN E MORELAND/
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/182,258	11/06/2018	2683	1720	SUN.LGI.417D3	20	2

CONFIRMATION NO. 1026

FILING RECEIPT

23557
SALIWANCHIK, LLOYD & EISENSCHENK
A PROFESSIONAL ASSOCIATION
PO Box 142950
GAINESVILLE, FL 32614

OC000000104101177

Date Mailed: 11/29/2018

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Ki Min LEE, Seoul, KOREA, REPUBLIC OF;
Jung Oh LEE, Seoul, KOREA, REPUBLIC OF;

Applicant(s)

LG INNOTEK CO., LTD., Seoul, KOREA, REPUBLIC OF;

Power of Attorney: The patent practitioners associated with Customer Number 23557

Domestic Priority data as claimed by applicant

This application is a CON of 15/673,763 08/10/2017 PAT 10153666
which is a CON of 15/195,390 06/28/2016 PAT 10069346
which is a CON of 13/658,116 10/23/2012 PAT 9461364

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
REPUBLIC OF KOREA 10-2011-0114721 11/04/2011

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Permission to Access Search Results: Yes

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If Required, Foreign Filing License Granted: 11/28/2018

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/182,258**

Projected Publication Date: 03/07/2019

Non-Publication Request: No

Early Publication Request: No

Title

Wireless Power Receiver and Control Method Thereof

Preliminary Class

340

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/182,258

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 460 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1720

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

DocCode – SCORE

SCORE Placeholder Sheet for IFW Content

Application Number: 16182258 Document Date: 11/06/2018

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

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Form Revision Date: August 26, 2013

I hereby certify that this correspondence is being electronically transmitted via EFS to the United States Patent and Trademark Office on November 6, 2018.

Jeff Lloyd, Patent Attorney, Reg. No. 35,589

CLAIM OF PRIORITY UNDER 35 USC §119
Patent Application
Docket No. SUN.LGI.417D3

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Ki Min Lee, Jung Oh Lee
Filed	:	November 6, 2018
For	:	Wireless Power Receiver and Control Method Thereof

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

CLAIM OF PRIORITY UNDER 35 USC §119

Sir:

Applicants in the patent application identified above hereby reaffirm their claim to the right of priority granted pursuant to 35 USC §119 based upon Korean Application No. 10-2011-0114721, filed November 4, 2011.

A certified copy of the above Korean application can be found in the parent application, U.S. Application No. 15/673,763 or in ancestral application U.S. Application No. 13/658,116 (now U.S. Patent No. 9,461,364). Applicants respectfully request that a certified copy of the foreign priority application be made of record in the subject application pursuant to MPEP 201.14(b).

Respectfully submitted,

Jeff Lloyd
Patent Attorney
Registration No. 35,589
Phone No.: 352-375-8100
Fax No.: 352-372-5800
Address: P.O. Box 142950
Gainesville, FL 32614-2950

JL/mrk

J:\SUN\LGI\417D3\PTO-misc\Claim-of-Priority.docx/mrk

PTO/AIA/01 (06-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	WIRELESS POWER RECEIVER AND CONTROL METHOD THEREOF

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: LEE, Ki Min Date (Optional): 2012. 10. 16.

Signature: _____

Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/SB/AIA01 form for each additional inventor.

PTO/AIA/01 (06-12)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	WIRELESS POWER RECEIVER AND CONTROL METHOD THEREOF

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: LEE, Jung Oh Date (Optional): 2012. 10. 16

Signature: _____

Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/SB/AIA01 form for each additional inventor.

PTO/AIA/82B(07-12)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in the attached transmittal letter.

■ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

23557

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

Name	Registration Number		Name	Registration Number

Please recognize or change the correspondence address for the application identified in the attached transmittal letter to:

■ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant:

☐ Inventor or Joint Inventor

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor

☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (*e.g.*, a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

SIGNATURE of Applicant for Patent

Signature	Jeong Joong Kim	Date	October 5, 2012
Name	Jeong-Joong Kim	Telephone	+82-31-436-7890
Title and Company	Vice President, LG Innotek Co., Ltd.		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below *.

☐ *Total of _____ forms are submitted.

I hereby certify that this correspondence is being electronically transmitted via EFS to the United States Patent and Trademark Office on November 6, 2018.

Jeff Lloyd, Patent Attorney, Reg. No. 35,589

INFORMATION DISCLOSURE STATEMENT
Patent Application
Docket No. SUN.LGI.417D3

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Ki Min Lee, Jung Oh Lee
Filed	:	November 6, 2018
For	:	Wireless Power Receiver and Control Method Thereof

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT
UNDER 37 CFR §§1.97 AND 1.98

Sir:

In accordance with 37 CFR §1.97 and §1.98, Applicants would like to bring to the attention of the Examiner the references cited in the following patent applications:

U.S. Serial No. 15/673,763, filed August 10, 2017;

U.S. Serial No. 15/195,390, filed June 28, 2016, now U.S. Patent No. 10,069,346, issued September 4, 2018; and

U.S. Serial No. 13/658,116, filed October 23, 2012, now U.S. Patent No. 9,461,364, issued October 4, 2016.

The subject application claims the benefit under 35 USC §120 of the filing date of patent application Serial Nos. 13/658,116; 15/195,390; and 15/673,763. In accordance with 37 CFR §1.98(d), Applicants respectfully request that the copies of references supplied in the Information Disclosure Statements of the 13/658,116; 15/195,390; and 15/673,763 applications as well as references cited during the prosecution thereof be made of record in the subject application. As copies of the references filed in the 13/658,116; 15/195,390; and 15/673,763 applications and cited on the attached form PTO/SB/08 can be found in the 13/658,116; 15/195,390; and 15/673,763 casefiles, copies of those references are not provided herewith.

J:\SUN\LGI\417D3\IDS-Refs\11-6-2018\IDS.doc/mrk

It is respectfully requested that the references cited in the 13/658,116; 15/195,390; and 15/673,763 applications be considered in the examination of the subject application and that their consideration be made of record.

Applicants respectfully assert that the substantive provisions of 37 CFR §§1.97 and 1.98 are met by the foregoing statements.

The Commissioner is hereby authorized to charge any fees under 37 CFR §§1.16 or 1.17 as required by this paper to Deposit Account No. 19-0065.

Respectfully submitted,

Jeff Lloyd
Patent Attorney
Registration No. 35,589
Phone No.: 352-375-8100
Fax No.: 352-372-5800
Address: P.O. Box 142950
Gainesville, FL 32614-2950

JL/mrk

Attachment: Form PTO/SB/08

J:\SUN\LGI\417D3\IDS-Refs\11-6-2018\IDS.doc/mrk

PTO/SB/08A (08-03)
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U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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Substitute for form 1449A/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 1 of 6

Complete if Known	
Application Number	
Filing Date	November 6, 2018
First Named Inventor	Ki Min Lee
Art Unit	
Examiner Name	
Attorney Docket Number	SUN.LGI.417D3

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Document Number Number - Kind Code [2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	U1	2004/0130915-A1	07-08-2004	David W. Baarman	ALL
	U2	2007/0182367-A1	08-09-2007	Partovi	ALL
	U3	2008/0197960-A1	08-21-2008	Hasegawa et al.	ALL
	U4	2008/0211455 -A1	09-04-2008	Park et al.	ALL
	U5	2009/0096413-A1	04-16-2009	Partovi et al.	ALL
	U6	2009/0237194-A1	09-24-2009	Waffenschmidt et al.	ALL
	U7	2009/0284082-A1	11-19-2009	Mohammadian	ALL
	U8	2009/0309550-A1	12-17-2009	Chih-Min Liu	ALL
	U9	2010/0066304-A1	03-18-2010	Masanori Oshimi	ALL
	U10	2010/0146308-A1	06-10-2010	Gioscia et al.	ALL
	U11	2010/0191306-A1	07-29-2010	Stevenson et al.	ALL
	U12	2011/0018358-A1	01-27-2011	Osamu Kozakai	ALL
	U13	2011/0025265-A1	02-03-2011	Mochida et al.	ALL
	U14	2011/0115303-A1	05-19-2011	Baarman et al.	ALL
	U15	2011/0127953-A1	06-02-2011	Walley et al.	ALL
	U16	2011/0217927-A1	09-08-2011	Ben-Shalom et al.	ALL
	U17	2011/0227420-A1	09-22-2011	Takashi Urano	ALL
	U18	2011/0316475-A1	12-29-2011	Jung et al.	ALL
	U19	2012/0205989-A1	08-16-2012	Baarman	ALL
	U20	2012/0282857-A1	11-01-2012	Zhang	ALL

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kind Codes of USPTO Patent Documents at www.uspto.gov or MPEP901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.

PTO/SB/08B (08-03)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 2 of 6

Complete if Known	
Application Number	
Filing Date	November 6, 2018
First Named Inventor	Ki Min Lee
Group Art Unit	
Examiner Name	
Attorney Docket Number	SUN.LGI.417D3

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Document Number Number - Kind Code [2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	U21	2013/0038278-A1	02-14-2013	Park et al.	ALL
	U22	2013/0113422-A1	05-09-2013	Lee et al.	ALL
	U23	5,430,618-A	07-04-1995	George Y. Huang	ALL
	U24	9,240,824-B2	01-19-2016	Hillan et al.	ALL
	U25	7,719,399-B2	05-18-2010	Iwasaki	ALL
	U26	8,922,160-B2	12-30-2014	Inoue	ALL
	U27	2008/0198560-A1	08-21-2008	FUJIWARA et al.	ALL
	U28	9,461,364-B2	10-04-2016	Lee et al.	ALL

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Foreign Patent Document Country Code [3] - Number [4] - Kind Code [5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T [6]
	F1	CN-10-1964678-A (With English Abstract) (Equivalent to 2011/0018358)	02-02-2011	Sony Corp.	ALL	
	F2	CN-10-1971453-A (With English Abstract) (Equivalent to US 2009/0096413)	02-09-2011	Mojo Mobility Inc.	ALL	
	F3	CN-10-2195366-A (With English Abstract) (Equivalent to US 2011/0227420)	09-21-2011	TDK Corp.	ALL	
	F4	CN-1768462-A (With English Abstract) (Equivalent to US 2004/0130915)	05-03-2006	Access Business Group Int., LLC.	ALL	
	F5	CN-2012-15827-Y (With English Abstract)	04-01-2009	Inventec Shanghai Electronics Co., Ltd.	ALL	
	F6	CN-20-1663492-U (With English Abstract)	12-01-2010	Fudatong Technology Corp.	ALL	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] Applicant's unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 3 of 6

Complete if Known	
Application Number	
Filing Date	November 6, 2018
First Named Inventor	Ki Min Lee
Group Art Unit	
Examiner Name	
Attorney Docket Number	SUN.LGI.417D3

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Foreign Patent Document: Country Code [3] - Number [4] - Kind Code [5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T [6]
	F7	CN-20-1749754-U (With English Abstract)	02-16-2011	Beijing MXH Device Ltd.	ALL	
	F8	EP-2367262-A2 (Equivalent to US 2011/0316475)	09-21-2011	Hanrim Postech Co., Ltd.	ALL	
	F9	JP-2006-302567-A (With English Abstract)	11-02-2006	Nec Tokin Corp., et al.	ALL	
	F10	JP-2010-073976-A (With English Abstract)	04-02-2010	Yazaki Corp.	ALL	
	F11	JP-2011-523336-A (With English Abstract) (Equivalent to US 2009/0284082)	08-04-2011	N/A	ALL	
	F12	KR-10-1298660-B1 (With English Abstract)	08-14-2013	Seoul Electronics & Telecom	ALL	
	F13	KR-10-2005-0105200-A (With English Abstract) (Equivalent of US 2012/0205989)	11-03-2005	Access Business Group International LLC	ALL	
	F14	KR-10-2008-0074640-A (with English Translation)	08-13-2008	Anyquitous Co., Ltd.	ALL	
	F15	KR-10-2008-0095643-A (With English Abstract)	10-29-2008	LS Cable Ltd.	ALL	
	F16	KR-10-2010-0112400-A (With English Abstract)	10-19-2010	LG Innotek Co., Ltd.	ALL	
	F17	KR-10-2011-0033836-A (with English Translation)	03-31-2011	Min Sun Cho	ALL	
	F18	KR-10-2011-0056334-A (With English Abstract) (Equivalent to US 2011/0217927)	05-26-2011	Powermat Ltd.	ALL	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kind Codes of USPTO Patent Documents at www.uspto.gov or MPEP901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 4 of 6

Complete if Known	
Application Number	
Filing Date	November 6, 2018
First Named Inventor	Ki Min Lee
Group Art Unit	
Examiner Name	
Attorney Docket Number	SUN.LGI.417D3

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Foreign Patent Document: Country Code [3] - Number [4] - Kind Code [5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T [6]
	F19	KR-10-2011-0120122-A (With English Abstract)	11-03-2011	Jong Ho Kim	ALL	
	F20	KR-10-2013-0015244-A (With English Abstract)	02-13-2013	LG Electronics Inc.	ALL	
	F21	KR-10-2013-0016588-A (With English Abstract) (Equivalent to US 2013/0038278)	02-18-2013	Samsung Electronics Co., Ltd.	ALL	
	F22	KR-10-2013-0049608-A (With English Abstract) (Equivalent to US 2013/0113422)	05-14-2013	LG Innotek Co., Ltd.	ALL	
	F23	KR-10-2013-0049781-A (With English Abstract)	05-14-2013	LG Innotek Co., Ltd.	ALL	
	F24	KR-10-2013-0072181-A (With English Abstract)	07-01-2013	Amosense Co., Ltd.	ALL	
	F25	TW-2009-52303-A (With English Abstract) (Equivalent to US 2009/0309550)	12-16-2009	KYE Systems Corp.	ALL	
	F26	TW-201132014-A (with English Abstract) (Equivalent to US 9,240,824)	09-16-2011	Qualcomm Incorporated	ALL	
	F27	WO-2007/015599-A1 (Equivalent to US 2008/0211455)	02-08-2007	LS Cable Ltd.	ALL	
	F28	WO-2010/047850-A1 (Equivalent to US 2009/0284082)	04-29-2010	Qualcomm Inc.	ALL	
	F29	JP-06-224043-A (with Machine Translation)	08-12-1994	-	ALL	
	F30	EP-0790667-A1 (with English Abstract)	08-20-1997	SCHLUMBERGER IND SA	ALL	
	F31	KR-10-2010-0067748-A (with English Abstract)	06-22-2010	HANRIM POSTECH CO., LTD	ALL	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kind Codes of USPTO Patent Documents at www.uspto.gov or MPEP901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

J:\SUN\LGI\417D3\IDS-Refs\11-6-2018\PTO-SB-08.doc/mrk

PTO/SB/08B (08-03)
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U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Substitute for form 1449B/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 5 of 6

Complete if Known	
Application Number	
Filing Date	November 6, 2018
First Named Inventor	Ki Min Lee
Group Art Unit	
Examiner Name	
Attorney Docket Number	SUN.LGI.417D3

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Foreign Patent Document: Country Code [3] - Number [4] - Kind Code [5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T [6]
	F32	JP-2009-247124-A (with English Abstract)	10-22-2009	PANASONIC CORP	ALL	
	F33	CN-101983466-A (with English Abstract)	03-02-2011	PANASONIC CORP	ALL	
	F34	CN-101517666-A (with English Abstract)	08-26-2009	PHILIPS INTELLECTUAL PROPERTY; KONINKLIJKE PHILIPS ELECTRONICS N.V	ALL	
	F35	CN-101286411-A (with English Abstract)	10-15-2008	SEIKO EPSON CORP	ALL	

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No. [1]	Include name of the author (in CAPITAL LETTERS), title of the article, (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T [2]
	R1	Office Action dated May 15, 2017 in Korean Application No. 10-2014-0081260.	
	R2	Office Action dated November 28, 2017 in Korean Application No. 10-2014-0081260.	
	R3	Office Action dated January 5, 2018 in Chinese Application No. 201610451640.3.	
	R4	Office Action dated January 11, 2018 in U.S. Application No. 15/195,390.	
	R5	Communication dated February 6, 2018 in European Application No. 12189931.4.	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kind Codes of USPTO Patent Documents at www.uspto.gov or MPEP901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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Substitute for form 1449B/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 6 of 6

Complete if Known	
Application Number	
Filing Date	November 6, 2018
First Named Inventor	Ki Min Lee
Group Art Unit	
Examiner Name	
Attorney Docket Number	SUN.LGI.417D3

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No. [1]	Include name of the author (in CAPITAL LETTERS), title of the article, (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	R6	Notice of Allowance dated October 23, 2013 in Korean Application No. 10-2011-0114721, filed November 4, 2011.	
	R7	Office Action dated December 26, 2012 in Korean Application No. 10-2011-0114721, filed November 4, 2011.	
	R8	Office Action dated January 6, 2014 in Korean Application No. 10-2013-0100314.	
	R9	Office Action dated July 22, 2013 in Korean Application No. 10-2011-0114721, filed November 4, 2011.	
	R10	Office Action dated June 26, 2014 in Chinese Application No. 201210432152.X.	
	R11	Search Report dated September 3, 2013 in Korean Application No. 10-2013-0100314, filed August 23, 2013.	
	R12	European Search Report dated February 17, 2015 in European Application No. 14167637.9.	
	R13	European Search Report dated February 18, 2015 in European Application No. 12189931.4.	
	R14	Office Action dated April 19, 2017 in Taiwanese Application No. 105133529.	
	R15	Office Action dated August 6, 2014 in Taiwanese Application No. 101139085.	
	R16	Office Action dated July 17, 2014 in Korean Application No. 10-2013-0018321.	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kind Codes of USPTO Patent Documents at www.uspto.gov or MPEP901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	Wireless Power Receiver and Control Method Thereof
First Named Inventor/Applicant Name:	KI MIN LEE
Filer:	Jeff Lloyd/Megan Kuchenthal
Attorney Docket Number:	SUN.LGI.417D3

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1720**

Electronic Acknowledgement Receipt

EFS ID:	34229555
Application Number:	16182258
International Application Number:	
Confirmation Number:	1026
Title of Invention:	Wireless Power Receiver and Control Method Thereof
First Named Inventor/Applicant Name:	KI MIN LEE
Customer Number:	23557
Filer:	Jeff Lloyd/Megan Kuchenthal
Filer Authorized By:	Jeff Lloyd
Attorney Docket Number:	SUN.LGI.417D3
Receipt Date:	06-NOV-2018
Filing Date:	
Time Stamp:	17:22:13
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$1720
RAM confirmation Number	110718INTEFSW00004227190065
Deposit Account	190065
Authorized User	Megan Kuchenthal
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	ADS.pdf	1823353 68969a3537bdf3120532ad3da87f4b3be982af0b	no	9
Warnings:					
Information:					
2		SUN-LGI-417D3-App-AF.pdf	148292 95fe5133e203e8dad01f776524a117ab44787a75	yes	19

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Specification	1	15
Claims	16	18
Abstract	19	19

Warnings:					
Information:					
3	Drawings-other than black and white line drawings	SUN-LGI-417D3-Figures-AF.pdf	136541 1e89d35846db19903d88421047ab959dc99a9a94	no	11
Warnings:					
Information:					
4	Request for USPTO to retrieve priority docs	Claim-of-Priority.pdf	61292 714652b82a10b63ff03f70d1aef7f85a6eee4355	no	1
Warnings:					
Information:					
5	Oath or Declaration filed	SUN-LGI-417D3-Exec-Dec-Af.pdf	167801 73200944a231b7e4060a14db43cf98781f0a8ef8	no	2

Warnings:					
Information:					
6	Power of Attorney	POA.pdf	60076 661ed07583d3c7a5f7ced369520c4586f09ded99	no	1
Warnings:					
Information:					
7		IDS.pdf	822990 1b26ccbe3e95e9803d5fa3a568c48d34c4a4ee22	yes	8

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	2
	Information Disclosure Statement (IDS) Form (SB08)	3	8

Warnings:					
Information:					
8	Fee Worksheet (SB06)	fee-info.pdf	34893 87113ad531671004822ce86c4d2f0d7c78409719	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	3255238		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SUN.LGI.417D3
	Application Number	
Title of Invention	Wireless Power Receiver and Control Method Thereof	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	KI MIN		LEE	

Residence Information (Select One) US Residency ● Non US Residency Active US Military Service

City	Seoul	Country of Residence [i]	KR

Mailing Address of Inventor:

Address 1	98, Huam-ro, Jung-gu		
Address 2			
City	Seoul	State/Province	
Postal Code	04637	Country [i]	KR

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	JUNG OH		LEE	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Seoul	Country of Residence [i]	KR

Mailing Address of Inventor:

Address 1	98, Huam-ro, Jung-gu		
Address 2			
City	Seoul	State/Province	
Postal Code	04637	Country [i]	KR

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SUN.LGI.417D3
	Application Number	
Title of Invention	Wireless Power Receiver and Control Method Thereof	

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	23557		
Email Address	JL@SLEPATENTS.COM	Add Email	Remove Email

Application Information:

Title of the Invention	Wireless Power Receiver and Control Method Thereof		
Attorney Docket Number	SUN.LGI.417D3	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	11	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	23557		

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SUN.LGI.417D3
	Application Number	
Title of Invention	Wireless Power Receiver and Control Method Thereof	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	
	Continuation of	15673763	2017-08-10	

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15673763	Continuation of	15195390	2016-06-28	10069346	2018-09-04

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15195390	Continuation of	13658116	2012-10-23	9461364	2016-10-04

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
10-2011-0114721	KR	2011-11-04	

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

PTO/AIA/14 (11-15)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SUN.LGI.417D3
	Application Number	
Title of Invention	Wireless Power Receiver and Control Method Thereof	

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SUN.LGI.417D3
	Application Number	
Title of Invention	Wireless Power Receiver and Control Method Thereof	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SUN.LGI.417D3
	Application Number	
Title of Invention	Wireless Power Receiver and Control Method Thereof	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	LG INNOTEK CO., LTD.		
Mailing Address Information For Applicant:			
Address 1	98, Huam-ro, Jung-gu		
Address 2			
City	Seoul	**State/Province**	
Country	KR	Postal Code	04637
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SUN.LGI.417D3
	Application Number	
Title of Invention	Wireless Power Receiver and Control Method Thereof	

Assignee 1

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SUN.LGI.417D3
	Application Number	
Title of Invention	Wireless Power Receiver and Control Method Thereof	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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WIRELESS POWER RECEIVER AND CONTROL METHOD THEREOF

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. Application No. 15/673,763, filed August 10, 2017; which is a continuation of U.S. Application No. 15/195,390, filed June 28, 2016, now U.S. Patent No. 10,069,346, issued on September 4, 2018; which is a continuation of U.S. Application No. 13/658,116, filed October 23, 2012, now U.S. Patent No. 9,461,364, issued on October 4, 2016; which claims the benefit under 35 U.S.C. §119 of Korean Patent Application No. 10-2011-0114721, filed November 4, 2011, all of which are incorporated herein by reference in their entirety.

BACKGROUND

[0001] The embodiment relates to a wireless power receiver and a control method thereof.

[0002] A wireless power transmission or a wireless energy transfer refers to a technology of wirelessly transferring electric energy to desired devices. In the 1800's, an electric motor or a transformer employing the principle of electromagnetic induction has been extensively used and then a method for transmitting electrical energy by irradiating electromagnetic waves, such as radio waves or lasers, has been suggested. Actually, electrical toothbrushes or electrical razors, which are frequently used in daily life, are charged based on the principle of electromagnetic induction. Until now, the long-distance transmission using the magnetic induction, the resonance and the short-wavelength radio frequency has been used as the wireless energy transfer scheme.

[0003] Recently, among wireless power transmitting technologies, an energy transmitting scheme employing resonance has been widely used.

[0004] Since an electric signal generated between the wireless power transmitter and the wireless power receiver is wirelessly transferred through coils in a wireless power transmitting system using electromagnetic induction, a user may easily charge electronic appliances such as a portable device.

[0005] However, due to the thickness of each of a receiving coil, a short-range communication antenna and a printed circuit board constituting a receiving side, a size of an

electronic appliance becomes larger and it is not easy to embed them in the electronic appliance. Specifically, the size of the electronic appliance is increased corresponding to the thickness of the receiving coil, the short-range communication antenna and the printed circuit board.

[0006] Further, when an overcurrent flows through the short-range communication module, it is difficult to effectively cope with the overcurrent.

[0007] Further, a magnetic field generated from the receiving coil exerts an influence on an inside of an electronic appliance, so that the electronic appliance malfunctions.

SUMMARY

[0008] The embodiment provides a wireless power receiver with a minimized thickness by suitably arranging a receiving coil, a short-range communication antenna and a printed circuit board.

[0009] The embodiment provides a wireless power receiver with a reduced thickness by allowing a short-range communication antenna to be included in a printed circuit board.

[0010] The embodiment provides a wireless power receiver which inhibits an electronic appliance from malfunctioning using a shielding unit.

[0011] The embodiment provides a wireless power receiver which breaks an overcurrent by using a protecting unit to protect a short-range communication module.

[0012] A wireless power receiver according to the embodiment wirelessly receives power from a wireless power transmitter. The wireless power receiver includes: a printed circuit board having a reception space in a predetermined area; a receiving coil disposed in the reception space of the printed circuit board for receiving power from the wireless power transmitter; and a short-range communication antenna disposed on the printed circuit board while surrounding the receiving coil.

[0013] A wireless power receiver according to the embodiment wirelessly receives power from a wireless power transmitter. The wireless power receiver includes: a short-range communication antenna for performing short-range communication; a receiving coil for wirelessly receiving power from the wireless power transmitter; and a switch for changing a conducting state of the short-range communication antenna according to a reception of the power, wherein the wireless power receiver opens or shorts the switch according to the reception of the power.

[0014] A method of controlling a wireless power receiver, which includes a short-range communication antenna for communicating with an outside, according to the embodiment includes determining whether power is received from a transmitting coil through electromagnetic induction; opening a switch which changes a conducting state of the short-range communication antenna when the power is received; identifying whether an amount of received power is equal to or greater than a threshold value; and shorting the switch when the amount of the received power is equal to or greater than the threshold value.

[0015] According to the embodiments, the thickness of the wireless power receiver can be minimized by suitably arranging the receiving coil, the short-range communication antenna and the printed circuit board.

[0016] According to the embodiments, the wireless power receiver can be inhibited from being broken by inhibiting an overcurrent from flowing in the wireless power receiver and malfunction of the wireless power receiver can be inhibited by shielding a magnetic field.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. 1 is a view showing a wireless power transmission system according to the embodiment;

[0018] FIG. 2 is an equivalent circuit diagram of a transmitting coil according to the embodiment;

[0019] FIG. 3 is an equivalent circuit diagram of the wireless power transmission system according to the embodiment;

[0020] FIG. 4 is a block diagram of a wireless power receiver according to the embodiment;

[0021] FIG. 5 is a view showing an example of a configuration of the wireless power receiver according to the embodiment;

[0022] FIG. 6 is an exploded perspective and sectional view illustrating the wireless power receiver according to the embodiment;

[0023] FIG. 7 is a sectional view showing an arrangement of elements of the wireless power receiver according to the embodiment;

[0024] FIG. 8 is a view illustrating a top surface and a bottom surface of the wireless power receiver according to the embodiment;

[0025] FIG. 9 is a view illustrating one example of attaching a shielding unit onto the wireless power receiver according to the embodiment;

[0026] FIG. 10 is a view illustrating one example of inserting the shielding unit into the wireless power receiver according to the embodiment; and

[0027] FIG. 11 is a flowchart illustrating a control method of the wireless power receiver according to the embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0028] Hereinafter, exemplary embodiments of the disclosure will be described in detail so that those skilled in the art can easily comprehend the disclosure.

[0029] FIG. 1 illustrates a wireless power transmission system according to an embodiment.

[0030] The power generated from a power source 100 is provided to a wireless power transmitter 200, such that the power is transferred by electromagnetic induction to a wireless power receiver 300.

[0031] In detail, the power source 100 is an AC power source for supplying AC power of a predetermined frequency.

[0032] The wireless power transmitter 200 includes a transmitting coil 210. The transmitting coil 210 is connected to the power source 100, such that an AC current flows through the transmitting coil 210. When the AC current flows through the transmitting coil 210, an AC current is induced to the receiving coil 310 physically apart from the transmitting coil 210 due to electromagnetic induction, so that the AC power is transferred to the wireless power receiver 300.

[0033] Power may be transferred by electromagnetic induction between two LC circuits which are impedance-matched with each other. The power transmission through electromagnetic induction may enable high efficiency power transmission.

[0034] The wireless power receiver 300 may include a receiving coil 310, a rectifier circuit 320 and a load 330. In the embodiment, the load 330 may be not included in the wireless power receiver 300, but may be provided separately. The power transmitted through the transmitting coil 210 is received at the receiving coil 310 by electromagnetic induction. The

power transferred to the receiving coil 310 is transferred through the rectifier circuit 320 to the load 330.

[0035] FIG. 2 is an equivalent circuit diagram of the transmitting coil 210 according to the embodiment.

[0036] As shown in FIG. 2, the transmitting coil 210 may include an inductor L1 and a capacitor C1, and form a circuit having a suitable inductance value and a suitable capacitance value. The capacitor C1 may be a variable capacitor. By controlling the variable capacitor, an impedance matching may be performed. Meanwhile, an equivalent circuit of the receiving coil 320 may be equal to that depicted in FIG. 2.

[0037] FIG. 3 is an equivalent circuit diagram of the wireless power transmitting system according to the embodiment.

[0038] As shown in FIG. 3, the transmitting coil 210 may include an inductor L1 having a predetermined inductance value and a capacitor C1 having a predetermined capacitance value.

[0039] Further, as shown in FIG. 3, the receiving coil 310 may include an inductor L2 having a predetermined inductance value and a capacitor C2 having a predetermined capacitance value. The rectifier circuit 320 may include a diode D1 and a rectifying capacitor C3 such that the rectifier circuit 320 converts AC power into DC power and outputs the DC power.

[0040] Although the load 330 is denoted as a DC power source, the load 330 may be a battery or other devices requiring DC power.

[0041] Next, a wireless power receiver according to the embodiment will be described with reference to FIGS. 4 to 10.

[0042] FIG. 4 is a block diagram of a wireless power receiver according to the embodiment, FIG. 5 is a view showing an example of a configuration of the wireless power receiver according to the embodiment, FIG. 6 is a exploded perspective and sectional view illustrating the wireless power receiver according to the embodiment, FIG. 7 is a sectional view showing an arrangement of elements of the wireless power receiver according to the embodiment, FIG. 8 is a view illustrating a top surface and a bottom surface of the wireless power receiver according to the embodiment, FIG. 9 is a view illustrating one example of attaching a shielding unit onto the wireless power receiver according to the embodiment, and FIG. 10 is a view illustrating one example of inserting the shielding unit into the wireless power receiver according to the embodiment.

[0043] First, referring to FIG. 4, the wireless power receiver 300 may include a receiving coil 310, a short-range communication antenna 340, a switch 350, a protecting unit 360, a short-range communication module 370, a shielding unit 380, and a controller 390.

[0044] The wireless power receiver 300 according to the embodiment may be installed in a terminal or an electronic appliance requiring power, such as a portable terminal, a laptop computer, and a mouse.

[0045] The receiving coil 310 receives power from the transmitting coil 210 of the wireless power transmitter 200 through electromagnetic induction. That is, if a magnetic field is generated as an AC current flows through the transmitting coil 210, a current is induced to the receiving coil 310 by the generated magnetic field so that an AC current flows therethrough.

[0046] In the embodiment, the receiving coil 310 may be disposed in a reception space of a printed circuit board 301.

[0047] The receiving coil 310 may be provided by winding a conducting wire server times. In the embodiment, the receiving coil 310 may have a spiral shape, but the embodiment is not limited thereto.

[0048] The short-range communication antenna 340 may communicate with a reader capable of performing a short-range communication. The short-range communication antenna 340 may perform a function of an antenna which transmits and receives information to and from the reader. In the embodiment, the short-range communication antenna 340 may be disposed at an outside of the receiving coil 310. In the embodiment, the receiving coil 310 may be disposed in the reception space inside the printed circuit board 301, and the short-range communication antenna 340 may be disposed to surround the receiving coil 310 on the printed circuit board 301.

[0049] The above configuration will be described in more detail with reference to FIG. 6.

[0050] Referring to the exploded perspective view of the wireless power receiver 300 shown in FIG. 6(a), the wireless power receiver 300 may include a case 302, the printed circuit board 301, the receiving coil 310, the short-range communication antenna 340 and the shielding unit 380. Here, the case 302 refers to a case of a portable terminal, but the embodiment is not limited thereto. The shielding unit 380 will be described later.

[0051] Referring to FIG. 6(a), it may be identified that the receiving coil 310 is disposed in the reception space A of the printed circuit board 301 and the short-range communication

antenna 340 is disposed on the printed circuit board 301. That is, the receiving coil 310 may be disposed in the reception space A provided inside the printed circuit board 301, and the short-range communication antenna 340 may be disposed at an upper side of the printed circuit board 301 while surrounding the reception space A.

[0052] FIG. 6 (b) is a sectional view showing the arrangement of the elements of the wireless power receiver 300 illustrated in FIG. 6(a).

[0053] In the embodiment, the printed circuit board 301, the receiving coil 310 and the short-range communication antenna 340 may be inserted into the case 302 through the injection molding. Further, as described above, the short-range communication antenna 340 may be disposed at an outer periphery on the printed circuit board 301 while surrounding the receiving coil 310 placed in the reception space A.

[0054] Hereinafter, the arrangement among the receiving coil 310, the short-range communication antenna 340 and the printed circuit board 301 will be described in more detail with reference to FIGS. 7 and 8.

[0055] First, referring to FIG. 7, the printed circuit board 301 has the reception space A in a predetermined area thereof. In the embodiment, the predetermined area may include the central portion of the printed circuit board 301. In the embodiment, the central portion of the printed circuit board 301 may have the reception space having a polygonal shape, such as a rectangular shape and a circular shape.

[0056] The receiving coil 310 is disposed in the reception space A of the printed circuit board 301, and receives power from the transmission induction coil 210 through electromagnetic induction. In the embodiment, the receiving coil 310 and the printed circuit board 301 may be manufactured such that the thickness of the receiving coil 310 may be equal to that of the printed circuit board 301 or the thickness of the receiving coil 310 may be less than that of the printed circuit board 301. In this case, the increase of the thickness of the wireless power receiver 300 due to the thicknesses of the receiving coil 310 and the short-range communication antenna 340 is inhibited, so that the wireless power receiver 300 can be easily embedded in the case of the portable terminal.

[0057] In the embodiment, the receiving coil 310 may be manufactured to have a shape in match with a shape of the reception space A of the printed circuit board 310. For example, when the shape of the reception space A of the printed circuit board 310 is rectangular, the

receiving coil 310 or the conducting wire may be wound in a rectangular shape. When the shape of the reception space A of the printed circuit board 310 is circular, the receiving coil 310 or the conducting wire may be wound in a circular shape. Thus, the receiving coil 310 or the conducting wire may have various shapes.

[0058] The short-range communication antenna 340 may be included in the printed circuit board 301 and may be configured to surround the receiving coil 310. In the embodiment, the short-range communication antenna 340 may be manufactured such that the short-range communication antenna 340 may be embedded in the printed circuit board 301, and may be configured to surround the outer periphery of the receiving coil 310 having various shapes such as a rectangular shape or a circular shape. In this case, the increase of the thickness of the wireless power receiver 300 due to the thickness of the printed circuit board 301 and the short-range communication antenna 340 can be inhibited so that the wireless power receiver 300 can be easily installed in the case of the portable terminal.

[0059] The wireless power receiver 300 may further include a shielding unit 380 for shielding a magnetic field generated by the receiving coil 310. In the embodiment, the shielding unit 380 may be disposed to cover an area occupied by the receiving coil 310. In the embodiment, the shielding unit 380 may be disposed on the receiving coil 310 and the short-range communication antenna 340 such that the shielding unit 380 may include the area occupied by the receiving coil 310 and the short-range communication antenna 340.

[0060] In the embodiment, the shielding unit 380 may have a reception space in a predetermined area thereof. A wireless charging circuit 375, which is place on the top surface of the printed circuit board 301, may be disposed in the reception space of the shielding unit 380. The wireless charging circuit 375 may include a rectifier circuit for converting AC power into DC power, a capacitor for removing a noise signal, and a main IC chip for performing the operation for the wireless power reception.

[0061] In the embodiment, the shielding unit 380 and the wireless charging circuit 375 may be manufactured such that the thickness of the shielding unit 380 may be equal to that of the wireless charging circuit 375 or the thickness of the shielding unit 380 may be less than that of the wireless charging circuit 375. In this case, the increase of the thickness of the wireless power receiver 300 due to the thicknesses of the shielding unit 380 and the wireless charging circuit 375

can be inhibited, so that the wireless power receiver 300 can be easily installed in the case of the portable terminal.

[0062] FIG. 8(a) is a view showing a bottom surface of the wireless power receiver according to the embodiment and FIG. 8(b) is a view showing a top surface of the wireless power receiver according to the embodiment.

[0063] FIG. 8(a) illustrates the arrangement of the printed circuit board 310, the receiving coil 310 and the short-range communication antenna 340 according to the embodiment. The printed circuit board 301 has a reception space A in the central area, and the receiving coil 310 having a rectangular shape is disposed in the reception space A. The short-range communication antenna 340 is embedded in the printed circuit board 301. In this case, the increase of the thickness of the wireless power receiver 300 due to the thickness of the printed circuit board 301 and the short-range communication antenna 340 can be inhibited, so that the wireless power receiver 300 can be easily installed in the case of the portable terminal.

[0064] Further, the receiving coil 310 and the printed circuit board 301 may be manufactured such that the thickness of the receiving coil 310 may be equal to that of the printed circuit board 301 or the thickness of the receiving coil 310 may be less than that of the printed circuit board 301. In this case, the increase of the thickness of the wireless power receiver 300 due to the thickness of the receiving coil 310 and the printed circuit board 301 can be inhibited, so that the wireless power receiver 300 can be easily installed in the case of the portable terminal.

[0065] FIG. 8 (b) illustrates the arrangement of the wireless charging circuit 375 and the shielding unit 380 according to the embodiment. The shielding unit 380 may have a reception space in a predetermined area thereof, and the wireless charging circuit 375 may be disposed in the reception space of the shielding unit 380.

[0066] In the embodiment, the shielding unit 380 and the wireless charging circuit 375 may be manufactured such that the thickness of the wireless charging circuit 375 may be equal to that of the wireless charging circuit 375 or the thickness of the shielding unit 380 may be less than that of the wireless charging circuit 375. In this case, the increase of the thickness of the wireless power receiver 300 due to the thickness of the shielding unit 380 and the wireless charging circuit 375 can be inhibited, so that the wireless power receiver 300 can be easily installed in the case of the portable terminal.

[0067] Referring again to FIG. 4, although various technologies can be applied to a short-range communication protocol used in the wireless communication antenna 340 and a short-range are communication module 370 which will be described below, NFC (Near Field Communication) may be preferably used for the wireless communication antenna 340 and the short-range communication module 370. The NFC is a technology for performing wireless communication in a short-range through the bandwidth of 13.56 MHz.

[0068] The switch 350 is connected to the short-range communication antenna 340 and receives an open or short signal from the controller 390 to be described below such that the switch 350 may change a conducting state of the short-range communication antenna.

[0069] If it is determined that the power is received from the transmitting coil 320, the switch 350 may receive the open signal from the controller 390 such that the switch 350 may break the current from flowing through the short-range communication antenna 340.

[0070] If the wireless power receiver 300 is charged with an amount of power equal to or higher than a threshold value, the switch 350 may receive the short signal from the controller 390 such that the switch 350 may conduct the current through the short-range communication antenna 340, so the switch 350 may allow the short-range communication antenna 340 to be operated.

[0071] The protecting unit 360 is operated when a current equal to or higher than a threshold current value flows through the protecting unit 360, such that the protecting unit 360 may break the current equal to or higher than the threshold current value from being transferred to the short-range communication module 370.

[0072] In the embodiment, as shown in FIG. 5, the protecting unit 360 may include at least one zener diode. The zener diode may allow only a current having a value equal to or less than a threshold current value to flow through a circuit. The threshold current value may be variably set and may be a limit value at which the short-range communication module 370 may be normally operated.

[0073] When a current transferred to the short-range communication antenna 340 has the threshold current value or above, the protecting unit 360 changes the flowing direction or the flow of the current to inhibit an overcurrent from flowing through the short-range communication module 370.

[0074] Referring to FIG. 5, if the current flowing through the short-range communication antenna 340 has the threshold current value or above, the protecting unit 350 is operated. Referring to FIG. 5, when the current flowing in the A-direction has the threshold current value or above, the current having the threshold current value or above flows into the zener diode placed at an upper side of the protecting unit 350.

[0075] In a case that the current flowing in the B-direction has the threshold current value or above, the same procedure is performed.

[0076] An overcurrent having the threshold current value or above flows through the zener diode and is discharged as thermal energy. That is, the protecting unit 360 may inhibit the overcurrent from flowing through the short-range communication module 370, so that damage of the communication module 370 may be inhibited.

[0077] Referring again to FIG. 4, the short-range communication module 370 may receive a current through the short-range communication antenna 340. Although various types of communication technologies can be applied to the short-range communication module 370, the NFC (Near Field Communication) protocol may be preferably used.

[0078] The shielding unit 380 may change a direction of the magnetic field generated from the receiving coil 310. The shielding unit 380 may absorb the magnetic field generated from the receiving coil 310 and may discharge the absorbed magnetic field as thermal energy.

[0079] That is, as the shielding unit 380 may change the direction of the magnetic field generated from the coil 310 or absorb and discharge the magnetic field as thermal energy, it is possible to inhibit the magnetic field from exerting bad influence upon any other elements inside an electronic appliance to which the wireless power receiver 300 is installed. That is, the shielding unit 380 can inhibit the malfunction caused by the magnetic field applied to other elements.

[0080] The shielding unit 380 may include ferrite, but the embodiment is not limited thereto.

[0081] The shielding unit 380 may be disposed at one side of the wireless power receiver 300.

[0082] Hereinafter, the arrangement of the shielding unit 380 on the wireless power receiver 300 will be described with reference to FIGS. 9 and 10.

[0083] First, referring to FIG. 9, after the short-range communication antenna 340 has been disposed on in the printed circuit board 301, the shielding unit 380 may be attached to one side of the printed circuit board 301 with an adhesive. The printed circuit board 301 comprises a plurality of layers wherein each layer of the plurality of layers is spaced apart from adjacent layers. The shielding unit 380 is disposed under the short-range communication antenna 340 or the receiving coil 310 (not shown in the Fig. 9).

[0084] Referring to FIG. 10, the printed circuit board 301 comprises a plurality of layers wherein each layer of the plurality of layers is spaced apart from adjacent layers, the short-range communication antenna 340 or the receiving coil 310 (not shown in the Fig. 10) is disposed in the printed circuit board 301. Moreover, the shielding unit 380 is disposed in the printed circuit board 301. The shielding unit 380 is disposed under the receiving coil 310 or the short-range communication antenna 340. The receiving coil 310 (not shown in the Fig. 10), the short-range communication antenna 340, and the shielding unit 380 are disposed between the plurality of layers of the printed circuit board 301. While the procedure of disposing the short-range communication antenna 340 or receiving coil(310)(not shown in the Fig. 10) in the printed circuit board 301 is being performed, the shielding unit 380 may be inserted into the printed circuit board 301. That is, unlike FIG. 9, since the shielding unit 380 is disposed in the printed circuit board 301, the procedure of disposing the shielding unit 380 may be included in the procedure of disposing the short-range communication antenna 340 without performing the procedure of disposing the shielding unit 380 at one side of the printed circuit board 301. That is, as described above, according to the embodiment shown in FIG. 8, when the shielding unit 380 is inserted into the printed circuit board 301, the entire thickness of the wireless power receiver 300 may be reduced corresponding to the thickness of the adhesive 303. Thus, a separate procedure of attaching the shielding unit 380 is not necessary, so the manufacturing process may be simplified.

[0085] Referring again to FIG. 4, the controller 390 may control an entire operation of the wireless power receiver 300.

[0086] The controller 390 may change an operating mode of the wireless power receiver 300 into a charging mode or a communication mode according to a reception of the power. In the embodiment, the charging mode may be that the wireless power receiver 300 does not communicate with an outside through the short-range communication module 370, but receives

power from the transmitting coil 210. The communication mode may be that the wireless power receiver 300 does not receive power from the transmitting coil 210, but communicate with an outside through the short-range communication module 370.

[0087] The controller 390 may change the conducting state of the short-range communication antenna 340 by opening or shorting the switch 350. If a current is induced to the receiving coil 310 in the state that the switch 350 is shorted, the controller 390 may open the switch 350 to change the operating mode of the wireless power receiver 300 into the charging mode. That is, if the controller 390 receives power from the transmitting coil 210, the controller 390 opens the switch 350 to inhibit the current from flowing through the short-range communication antenna 340. In the state that the switch 350 is opened, if a current is not induced to the receiving coil 310, the controller 390 may short the switch 350 to change the operating mode of the wireless power receiver 300 into the communication mode. That is, if the controller does not receive power from the transmitting coil 210, the controller 390 may short the switch 350 to allow a current to conduct the short-range communication antenna 340.

[0088] The controller 390 may sense the current flowing through the receiving coil 310 for changing the conductive state of the short-range communication antenna 340. In another embodiment, the wireless power receiver 300 may further include a separate current sensing unit (not shown) which can sense the current induced to the receiving coil 310 to sense the current flowing through the receiving coil 310.

[0089] The controller 390 may open or short the switch 350 according to an amount of power received at the wireless power receiver 300. This will be described below with reference to FIG. 11.

[0090] FIG. 11 is a flowchart illustrating a control method of the wireless power receiver according to the embodiment.

[0091] Hereinafter, the control method of the wireless power receiver according to the embodiment will be described with reference to FIGS. 1 to 10.

[0092] In step S101, the controller 390 may determine whether the receiving coil 310 receives power from the transmitting coil 210 through electromagnetic induction. In the embodiment, the wireless power receiver 300 may further include a detecting unit (not shown) to determine whether power is received. A detecting coil may be used as the detecting unit.

[0093] In step S103, if it is determined that the receiving coil 310 receives power from the transmitting coil 210 through electromagnetic induction, the switch 350, which changes the conductive state of the short-range communication antenna 340, may be opened. That is, the controller 390 may transmit an open signal to the switch 350 to inhibit the current from flowing through the short-range communication antenna 340. In the embodiment, when it is determined that the receiving coil 310 receives power from the transmitting coil 210 through electromagnetic induction, the wireless power receiver 300 may be in the charging mode. When the wireless power receiver 200 is operated in the charging mode to receive power from the transmitting coil 310, the current flowing through the short-range communication antenna must be shut off because the magnetic field generated during the charging mode may interfere with the communication between the short-range communication module 370 and the outside.

[0094] Then, in step S105, the controller 390 may determine whether the amount of power received at the wireless power receiver 300 is more than the threshold value. In the embodiment, although the threshold value corresponds to the state that the wireless power receiver 300 is charged at 100%, the threshold value is not limited thereto and may be variously set by a user.

[0095] Then, in step S107, when the amount of power has the threshold value or above, the controller 390 allows the switch to be shorted. In this case, the wireless power receiver 300 terminates the charging mode and operates in the communication mode.

[0096] Then, in step S109, the controller 390 determines whether the current flowing through the short-range communication antenna 340 is equal to or greater than the threshold current value. In step S111, when the current flowing through the short-range communication antenna 340 is equal to or greater than the threshold current value, the current flowing direction may be changed. In the embodiment, the threshold current value may mean a limit value allowing the short-range communication to be operated normally. In the embodiment, the threshold current value may be variously set by a user. In the embodiment, the change of the current flowing direction may be performed through the protecting unit 360. In the embodiment, the protecting unit 360 may be a zener diode. If the current having the threshold current value or above flows, the zener diode performs the function of discharging the current as thermal energy. In this case, the zener diode may inhibit an overcurrent from flowing through the short-range

communication module 370, such that damage of the short-range communication module 370 may be inhibited.

Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

CLAIMS

What is claimed is:

1. A wireless power receiver, comprising:

a shielding unit;

a first layer on the shielding unit;

a wireless receiving coil on the first layer;

a second layer on the wireless receiving coil;

a first region disposed between the first layer and the second layer and vertically overlapping the wireless receiving coil; and

a second region disposed between the first layer and the second layer and not vertically overlapping the wireless receiving coil,

wherein a first distance between the first layer and the second layer in the first region is greater than a second distance between the first layer and the second layer in the second region.

2. The wireless power receiver of claim 1, wherein the second distance is smaller than a thickness of the wireless receiving coil.

3. The wireless power receiver of claim 1, further comprising:

a short-range communication antenna on the first layer.

4. The wireless power receiver of claim 3, further comprising:

a third region disposed between the first layer and the second layer and vertically overlapping the short-range communication antenna; and

a fourth region disposed between the first layer and the second layer and not vertically overlapping the short-range communication antenna,

wherein a third distance between the first layer and the second layer in the third region is greater than a fourth distance between the first layer and the second layer in the fourth second region.

5. The wireless power receiver of claim 4, wherein the fourth distance is smaller than a thickness of the short-range communication antenna.

6. The wireless power receiver of claim 1, comprising:

a third layer under the shielding unit.

7. The wireless power receiver of claim 1, comprising:

an adhesive disposed between the shielding unit and the first layer.

8. The wireless power receiver of claim 1, wherein the shielding unit has a reception space in a predetermined area.

9. A wireless power receiver, comprising:

a shielding unit;

a first layer on the shielding unit;

a wireless receiving coil on the first layer;

a second layer on the wireless receiving coil;

a first region disposed between the first layer and in which the first layer and the second layer contact the wireless receiving coil; and

a second region disposed between the first layer and the second layer and having a first separated space in which the first layer and the second layer do not contact the wireless receiving coil.

10. The wireless power receiver of claim 9, wherein the first separated space is disposed on a side surface of the wireless receiving coil.

11. The wireless power receiver of claim 9, wherein a first distance between the first layer and the second layer in the first region is greater than a second distance between the first layer and the second layer in the second region.

12. The wireless power receiver of claim 11, wherein the second distance is smaller than a thickness of the wireless receiving coil.

13. The wireless power receiver of claim 9, further comprising:

a short-range communication antenna on the first layer.

14. The wireless power receiver of claim 13, further comprising:

a third region disposed between the first layer and the second layer and in which the first layer and the second layer contact the short-range communication antenna; and

a fourth region disposed between the first layer and the second layer and having a second separated space in which the first layer and the second layer do not contact the short-range communication antenna.

15. The wireless power receiver of claim 14, wherein the second separated space is disposed on a side surface of the wireless receiving coil.

16. The wireless power receiver of claim 14, wherein a third distance between the first layer and the second layer in the third region is greater than a fourth distance between the first layer and the second layer in the fourth second region.

17. The wireless power receiver of claim 16, wherein the fourth distance is smaller than a thickness of the wireless receiving coil.

18. The wireless power receiver of claim 9, comprising:

a third layer under the shielding unit.

19. The wireless power receiver of claim 9, comprising:

an adhesive disposed between the shielding unit and the first layer.

20. The wireless power receiver of claim 9, wherein the shielding unit has a reception space in a predetermined area.

ABSTRACT

A wireless power receiver according to an embodiment wirelessly receives power from a wireless power transmitter. The wireless power receiver includes a printed circuit board having a reception space in a predetermined area, a receiving coil disposed in the reception space of the printed circuit board for receiving power from the wireless power transmitter, and a short-range communication antenna disposed on the printed circuit board while surrounding the receiving coil.

FIG.1

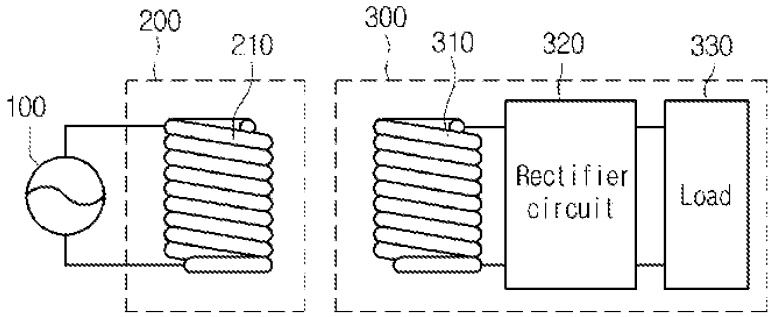


FIG.2

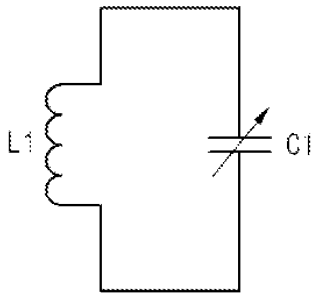


FIG.3

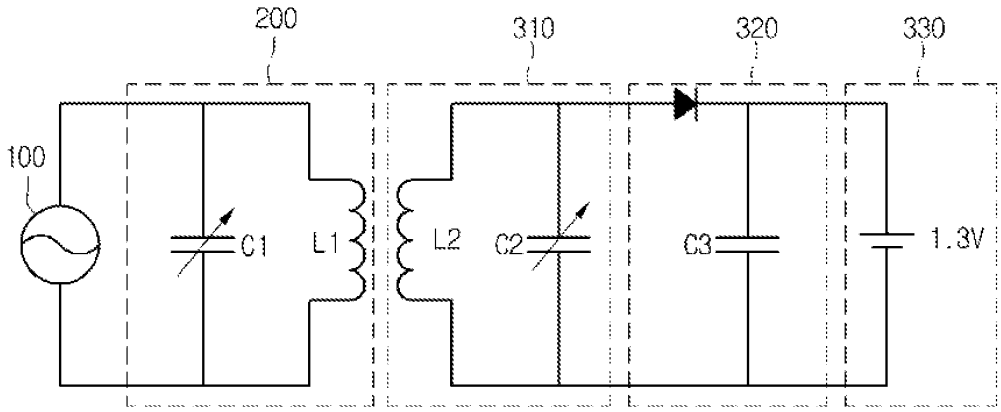


FIG.4

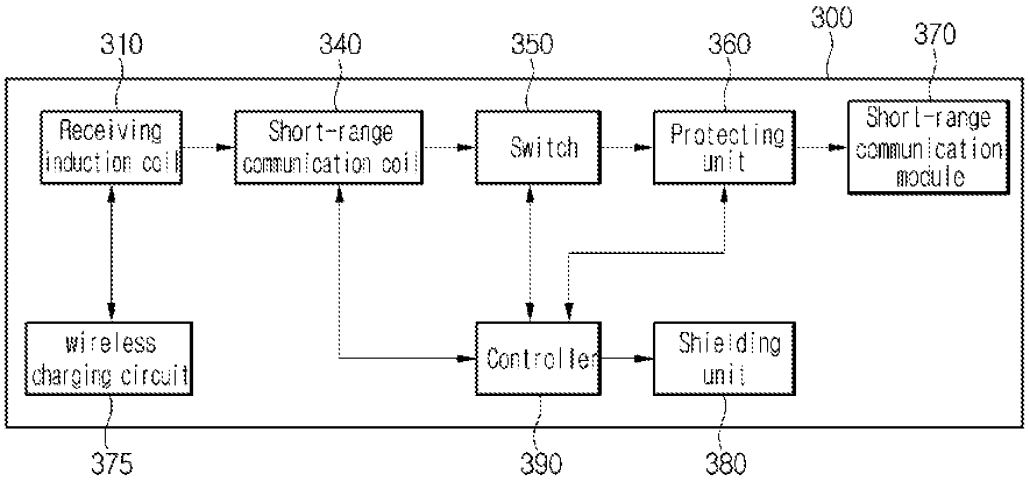

300
310
340
350
360
370
Receiving induction coil
Short-range communication coil
Switch
Protecting unit
Short-range communication module
wireless charging circuit
Controller
Shielding unit
375
390
380

FIG.5

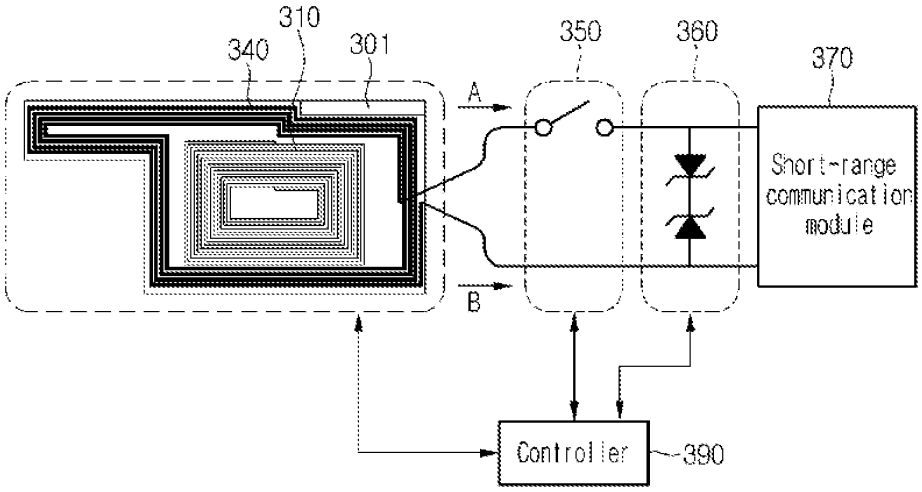
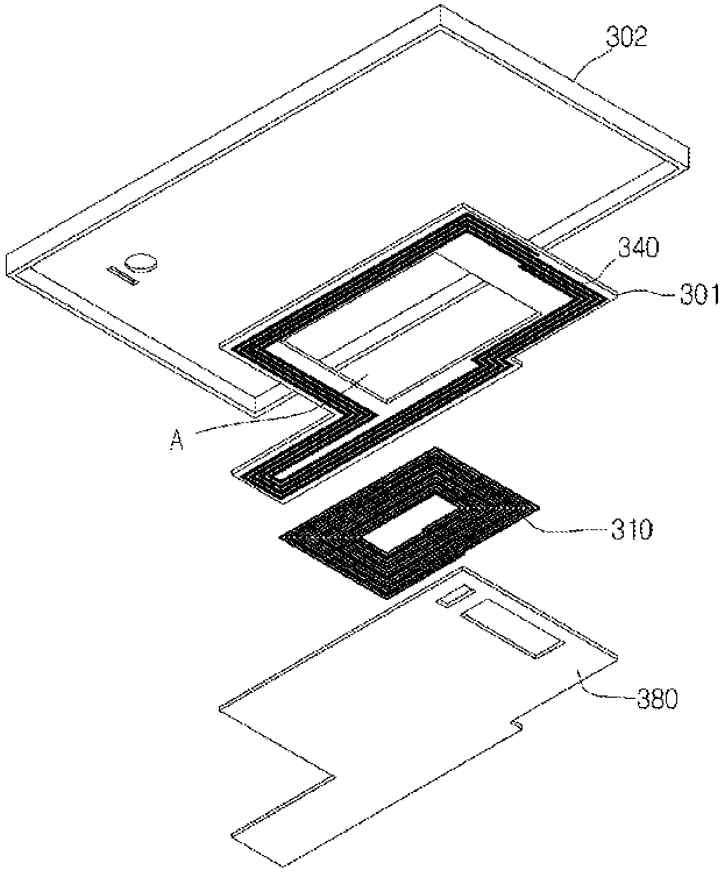
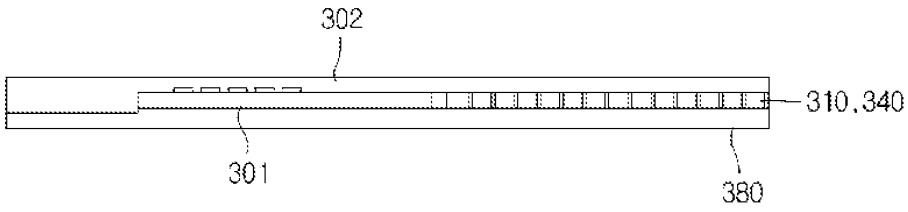

310
340
301
350
360
370
A
B
Short-range communication module
Controller
390

FIG.6



(a)



(b)

FIG.7

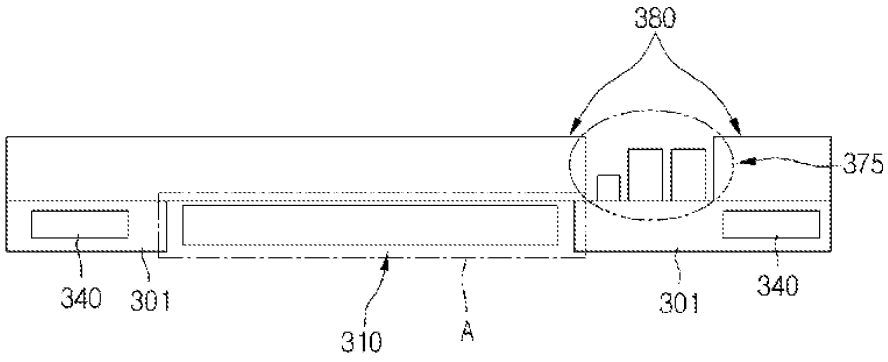


FIG.8

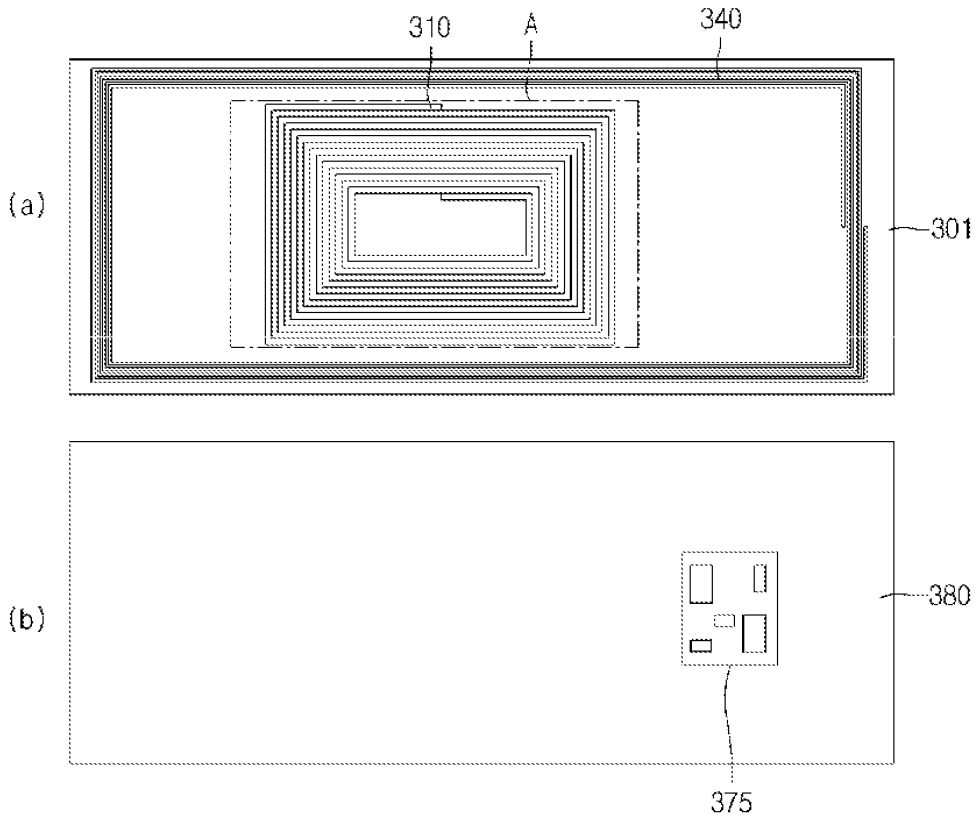


FIG.9

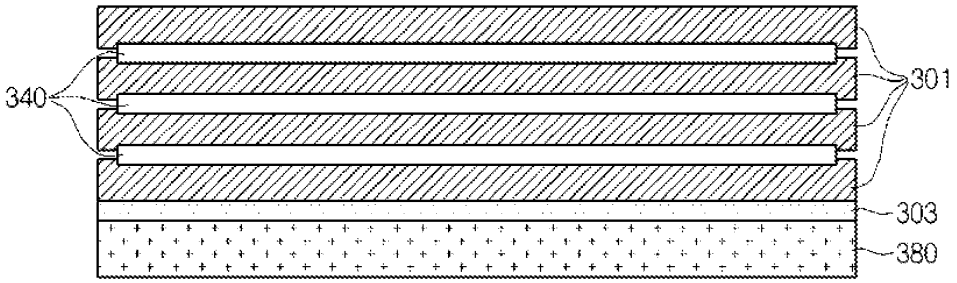


FIG.10

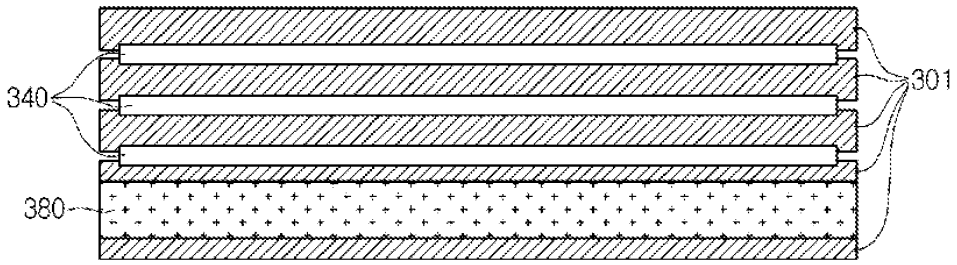
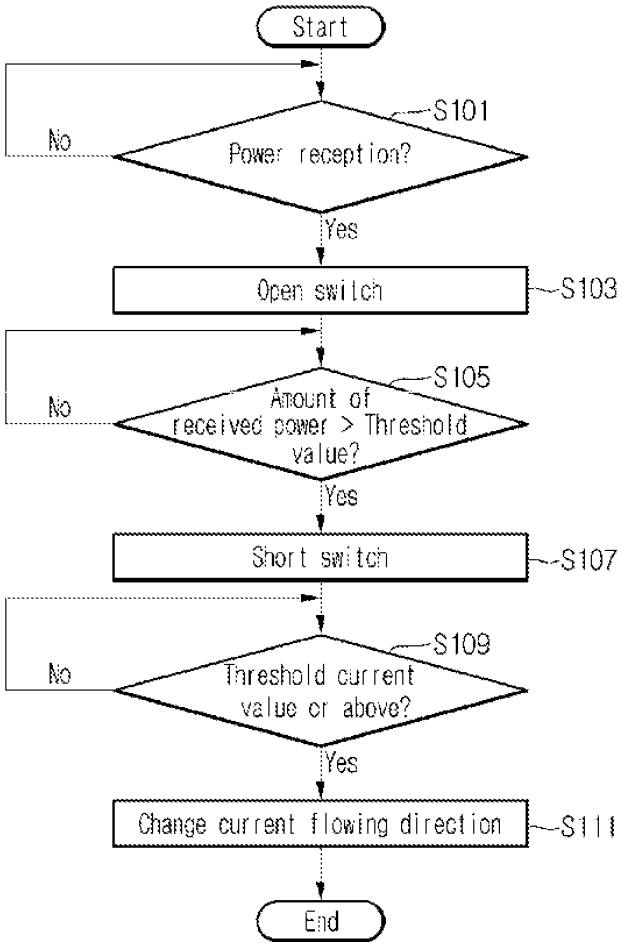


FIG.11


Start
S101
Power reception?
No
Yes
Open switch
S103
S105
Amount of received power > Threshold value?
No
Yes
Short switch
S107
S109
Threshold current value or above?
No
Yes
Change current flowing direction
S111
End