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(54) **METHOD AND APPARATUS FOR MANUFACTURING ELECTRONIC COMPONENT-MOUNTED COMPONENT, AND ELECTRONIC COMPONENT-MOUNTED COMPONENT**

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(51) **Int. Cl.**[7] **H01L 21/44**; H01L 21/48; H01L 21/50

(52) **U.S. Cl.** **438/106**; 438/121; 438/124

(57) **ABSTRACT**

After a first electronic component is inserted in a base substrate, first circuit patterns are formed on the inserted first electronic component, and then a second electronic component is mounted on the first circuit patterns to complete an electronic component-mounted component. According to the above method, the thickness of a module may be decreased by the thickness of the base substrate. Further, since the electronic component is surface-mounted, electronic components of arbitrary sizes and types may be used.

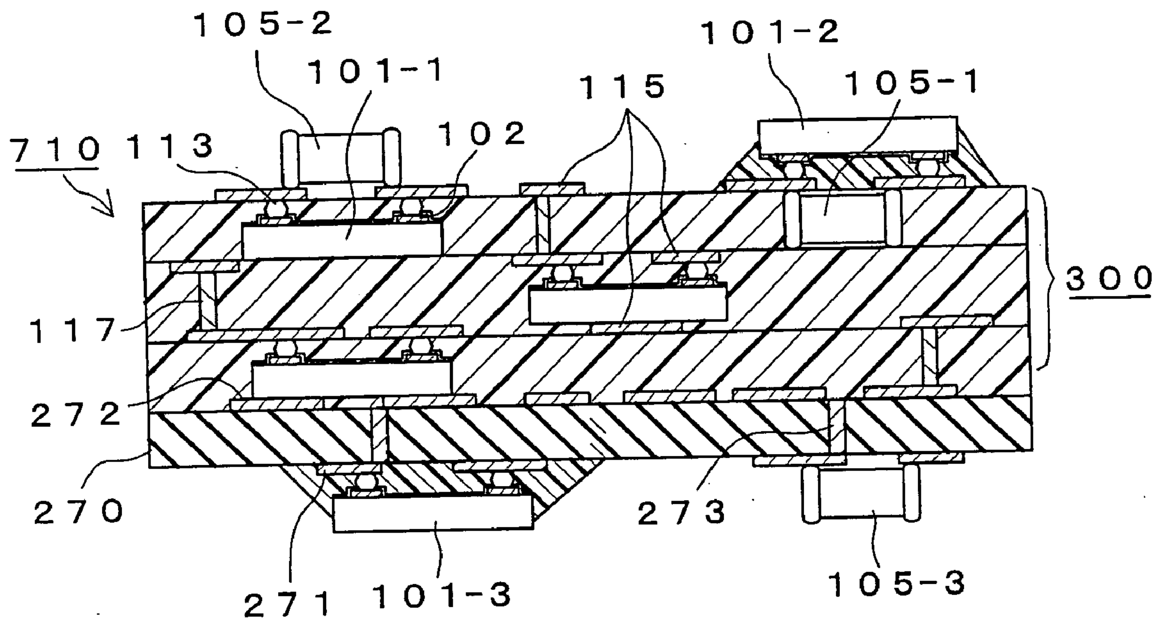


Fig. 1

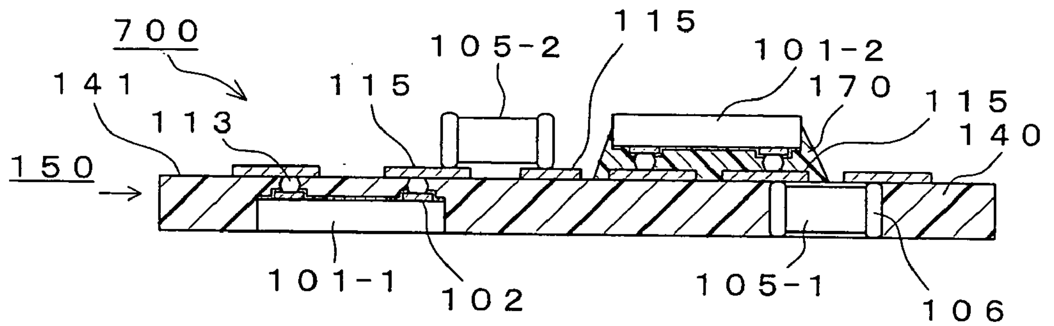
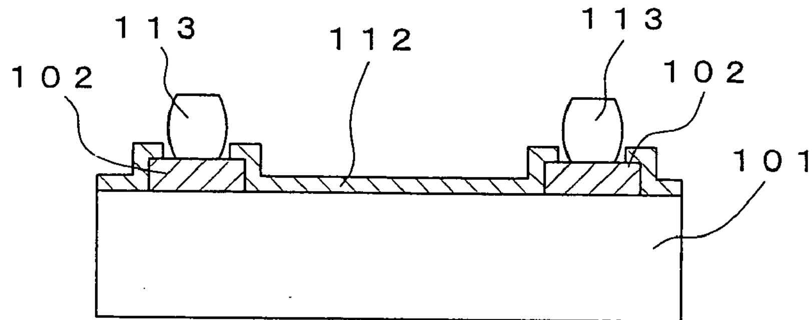


Fig. 2



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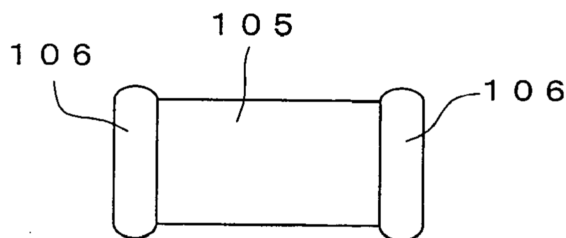

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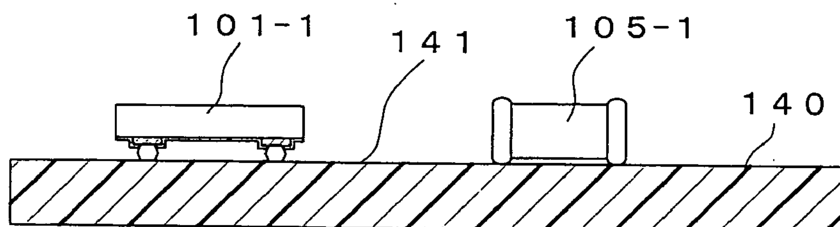

Fig. 5

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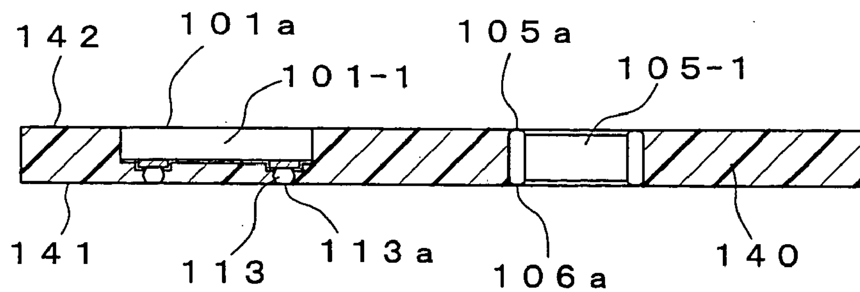
Fig. 6



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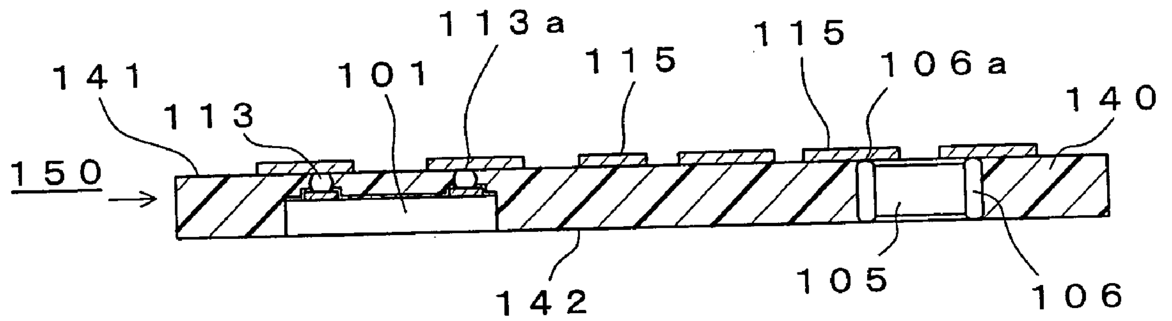

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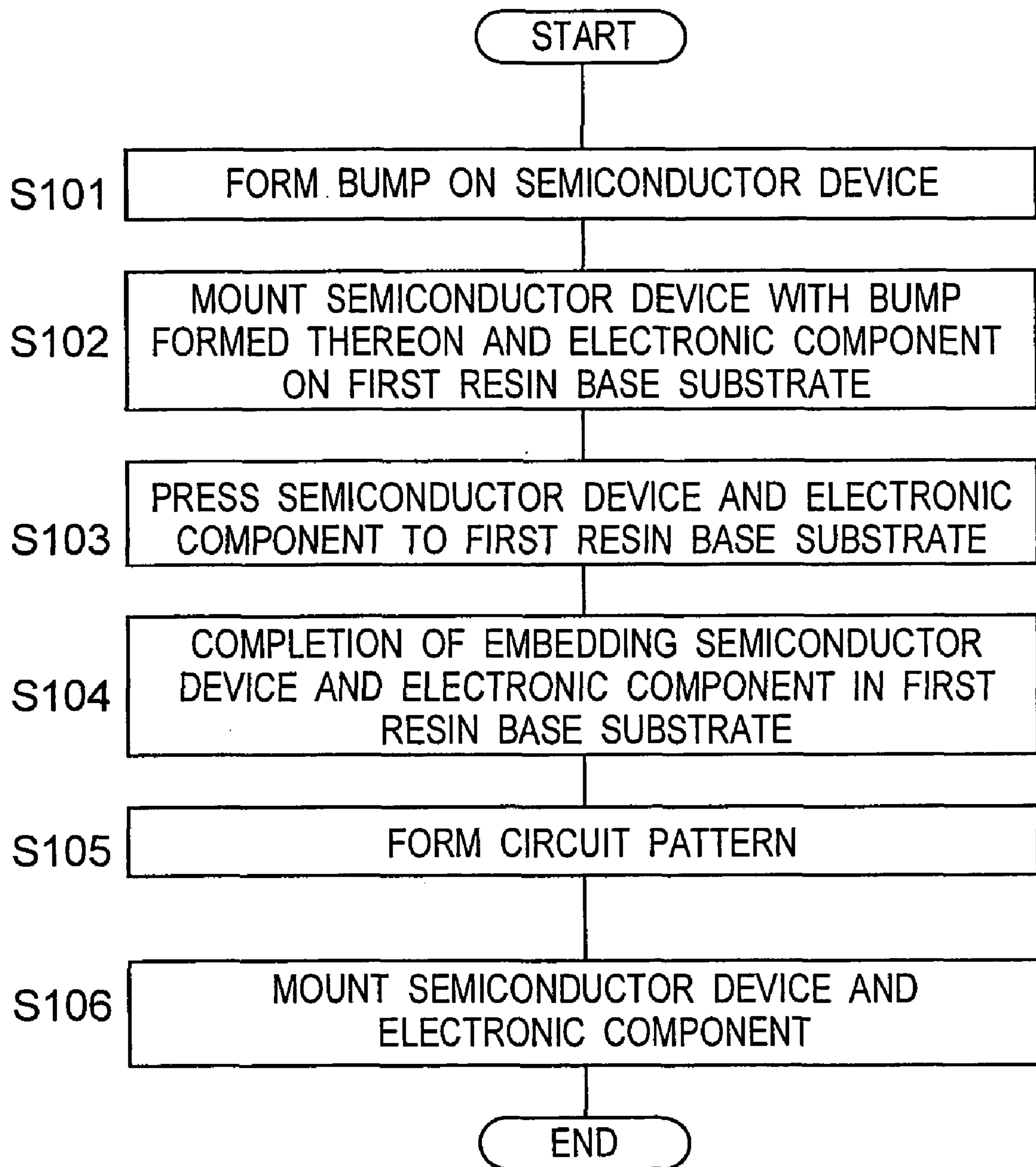

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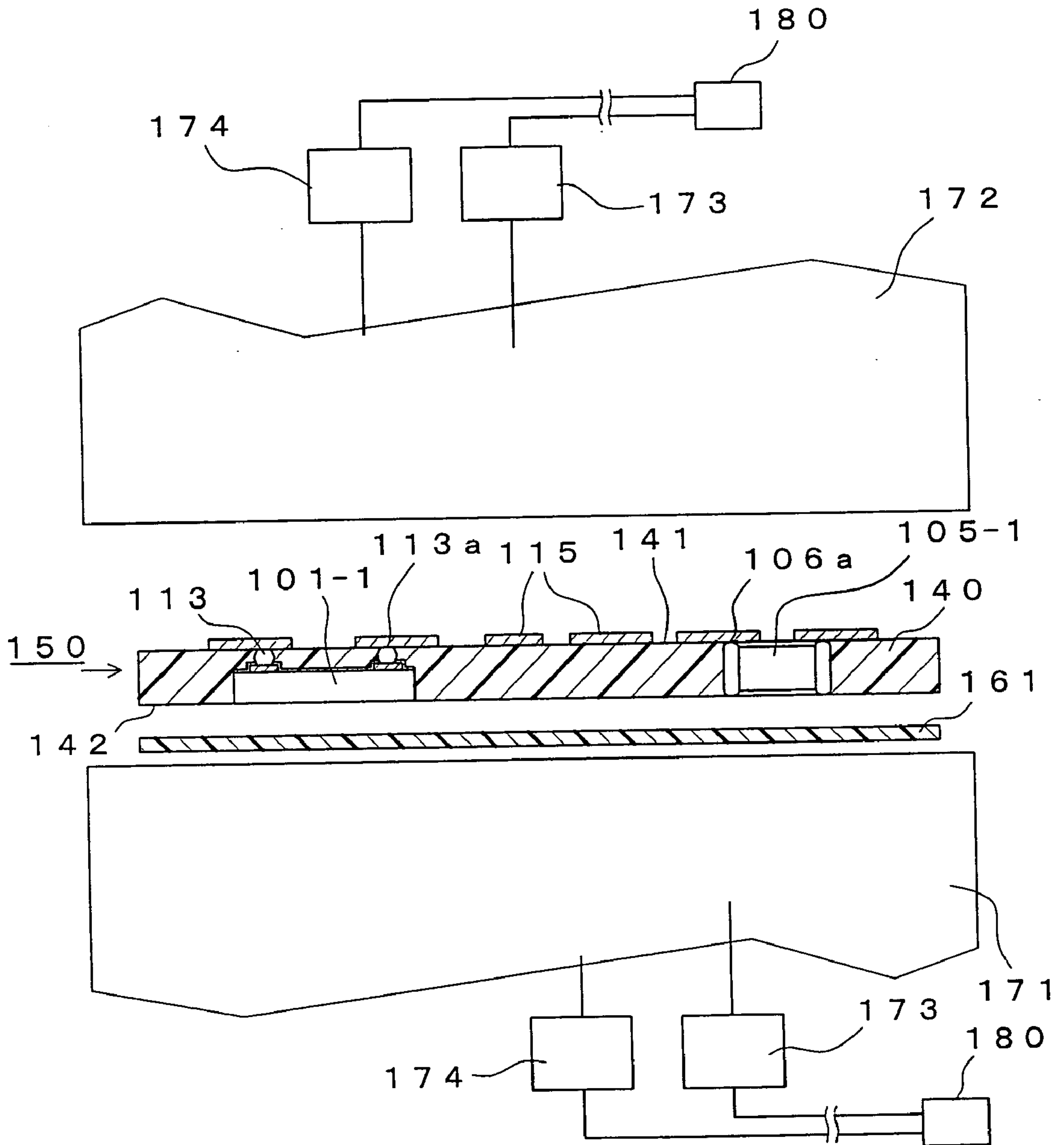

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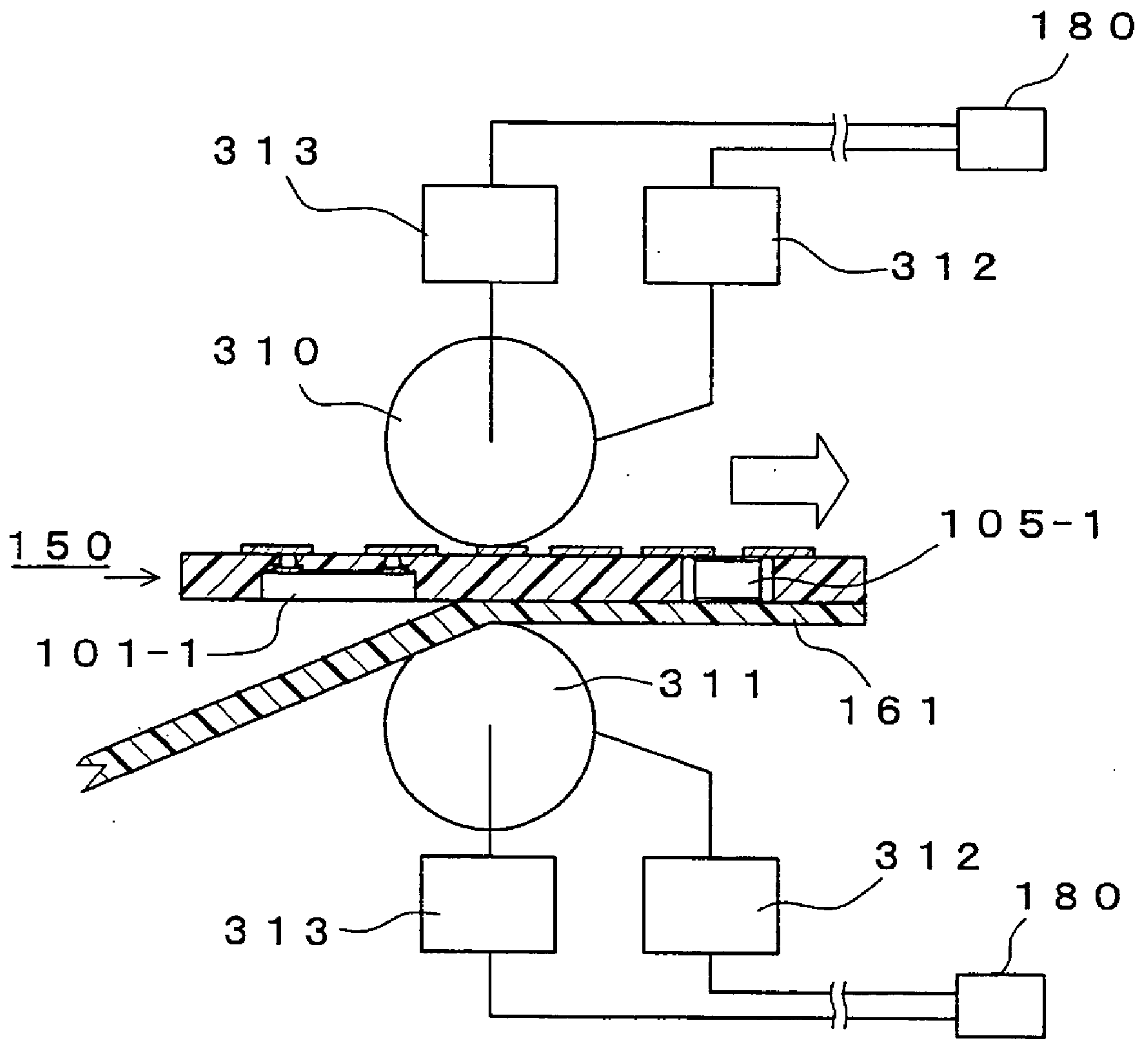

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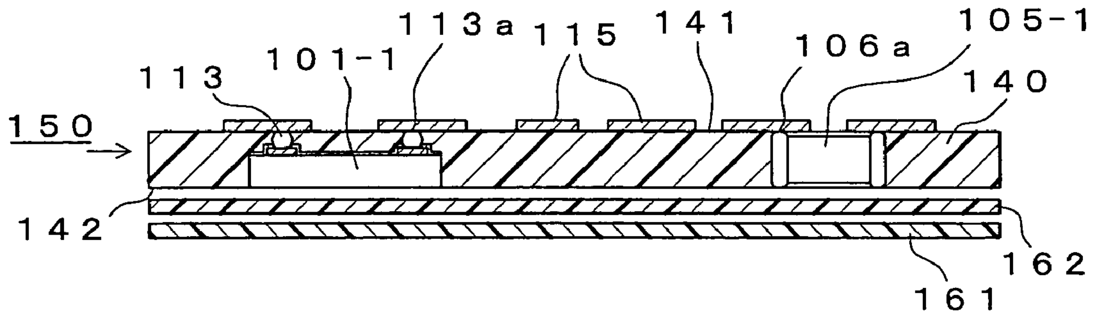

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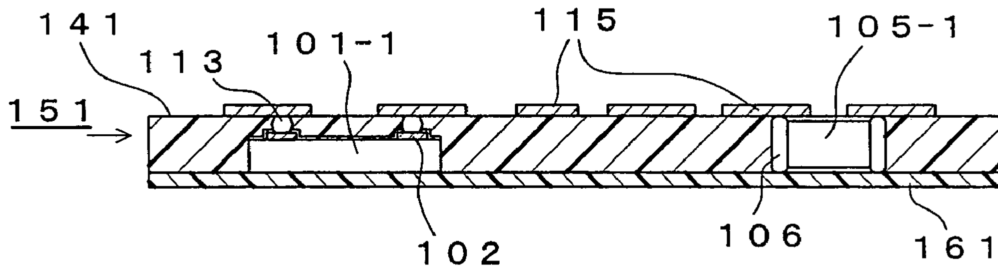

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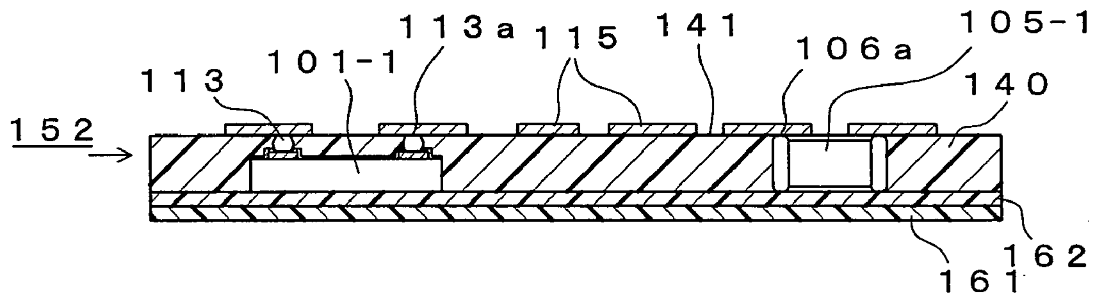

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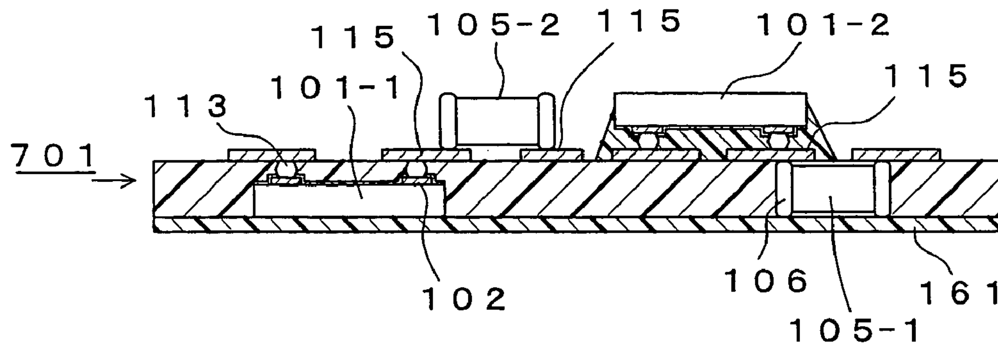

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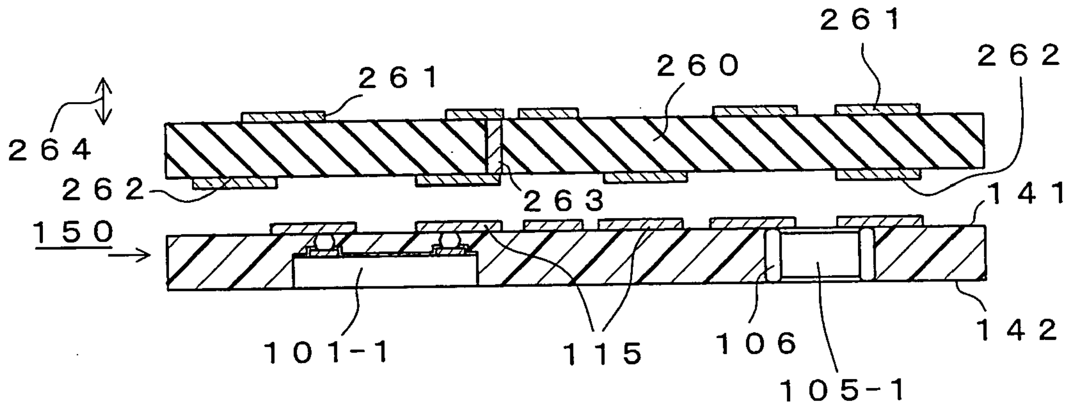

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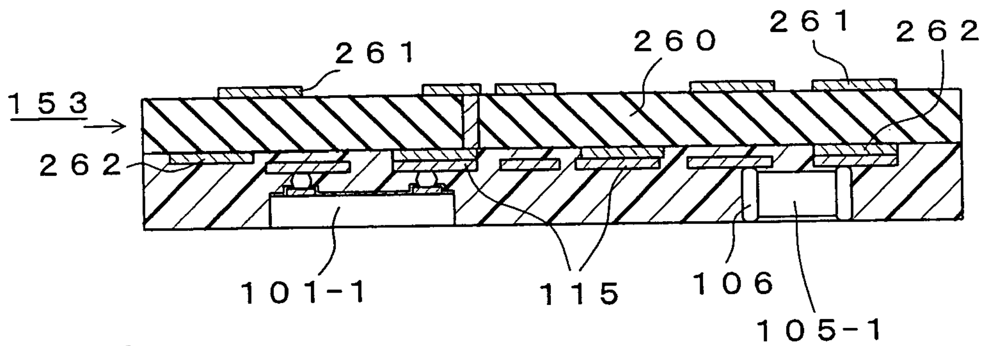

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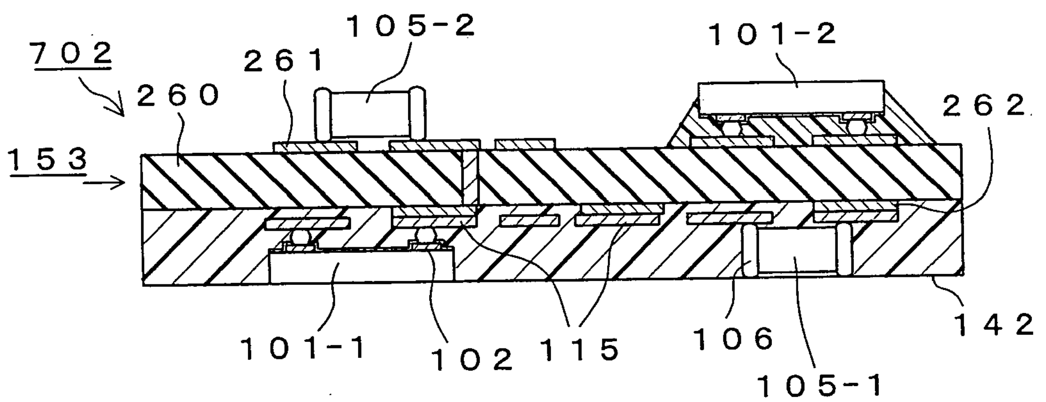

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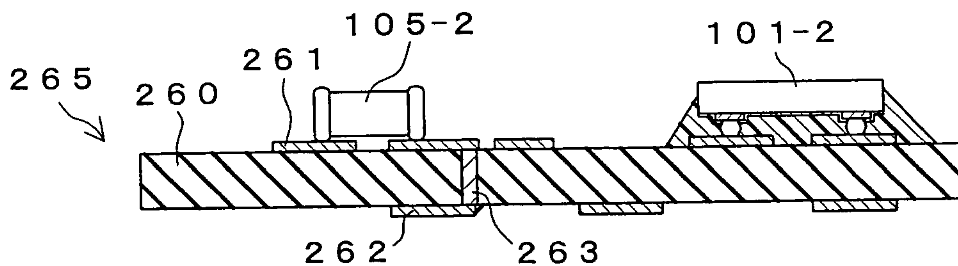

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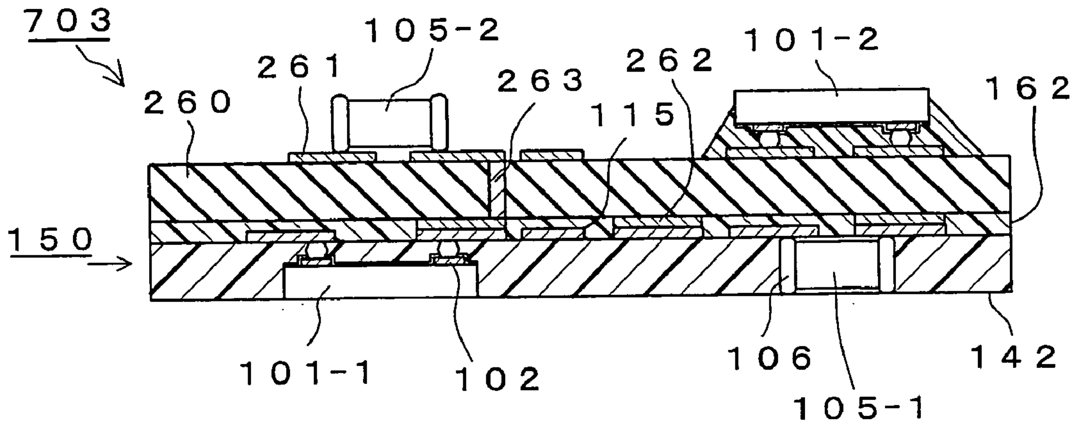

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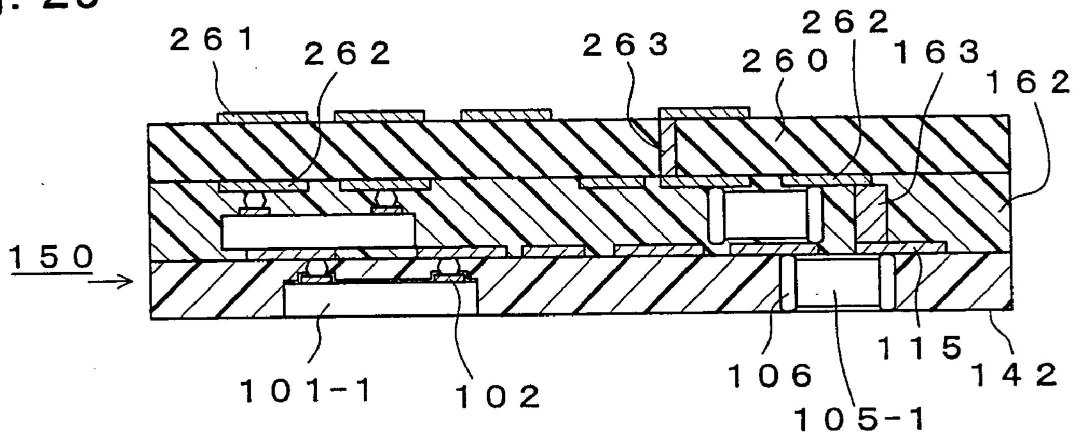

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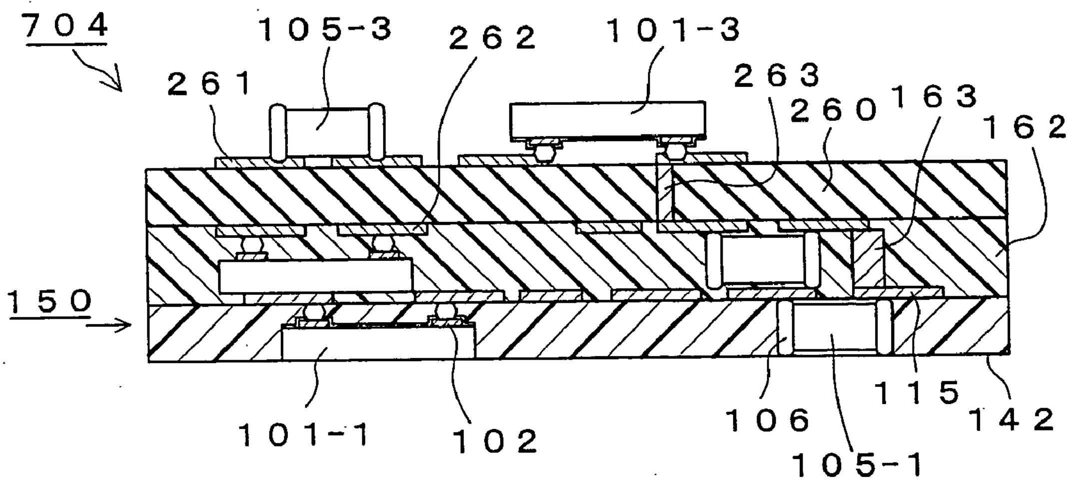

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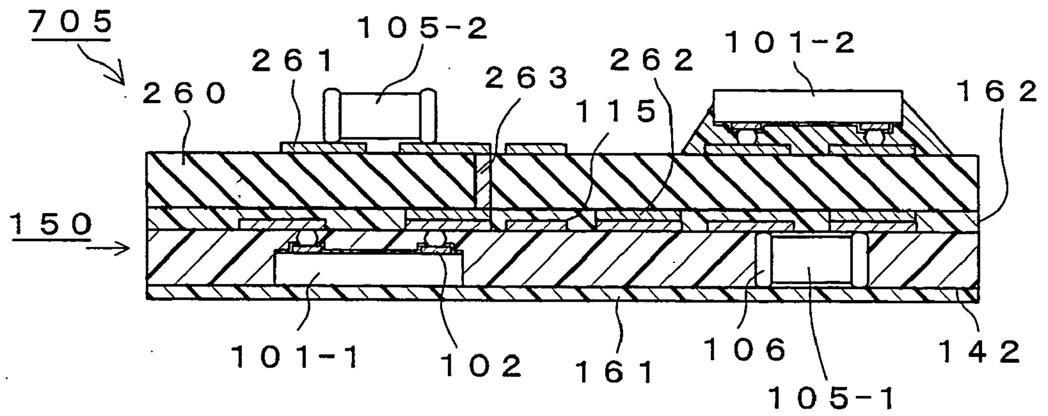

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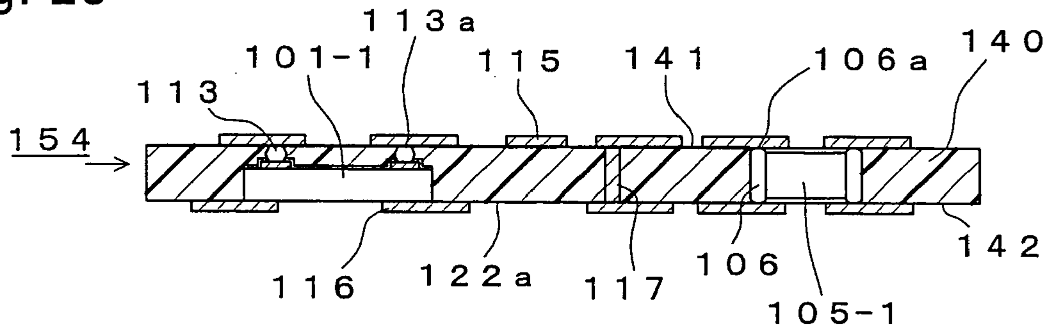

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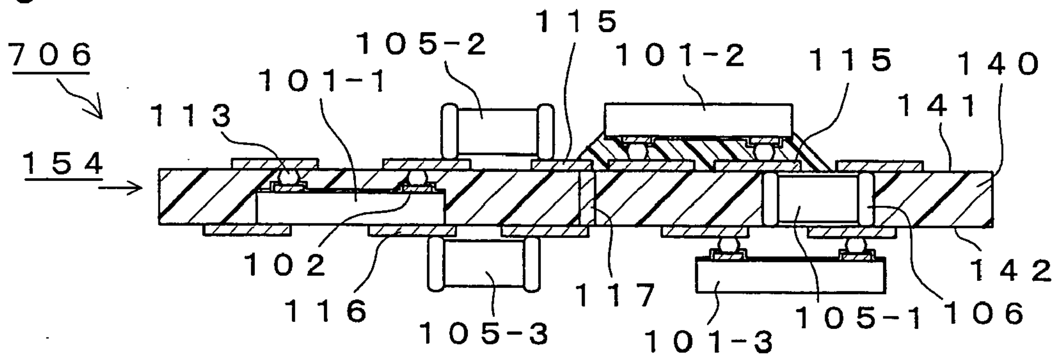

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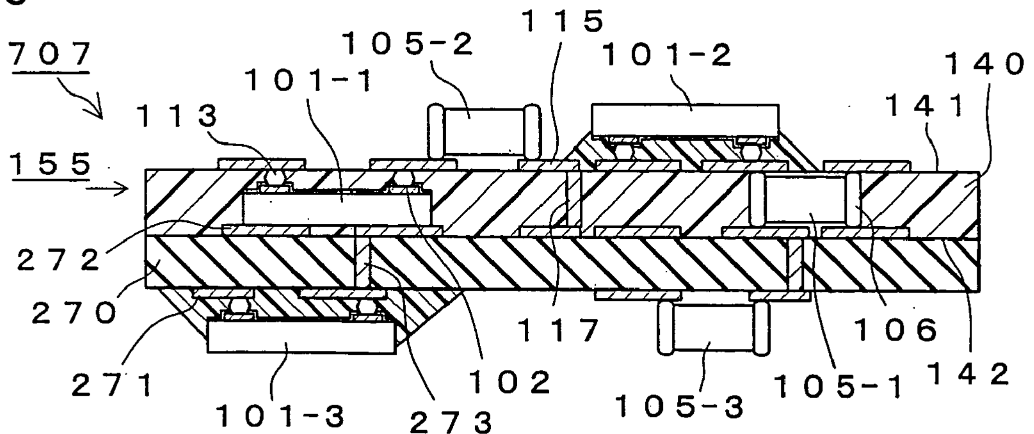

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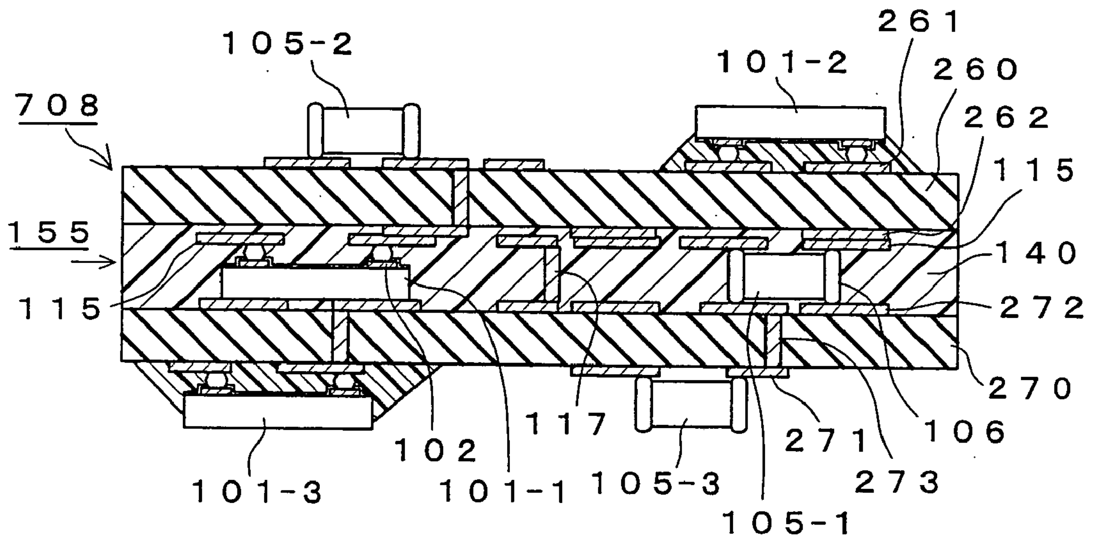

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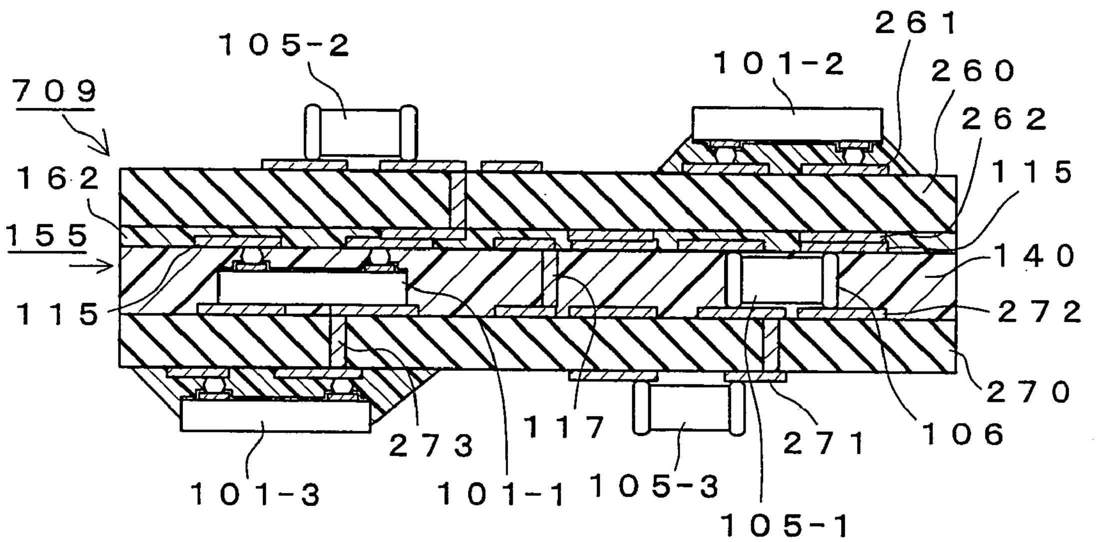

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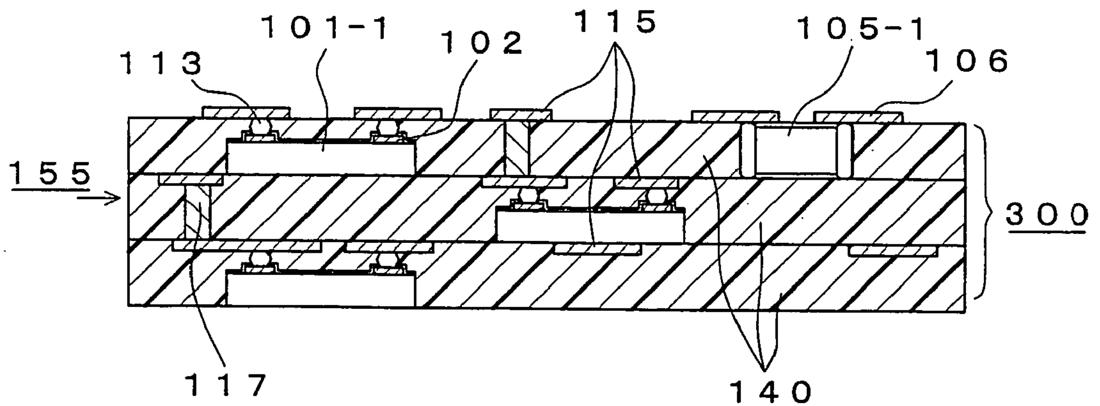

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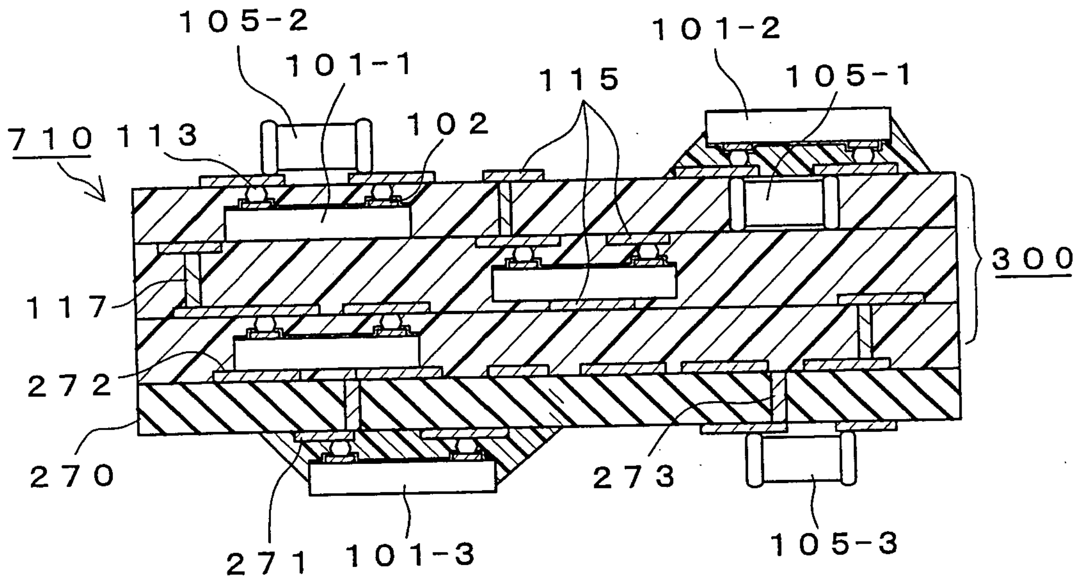

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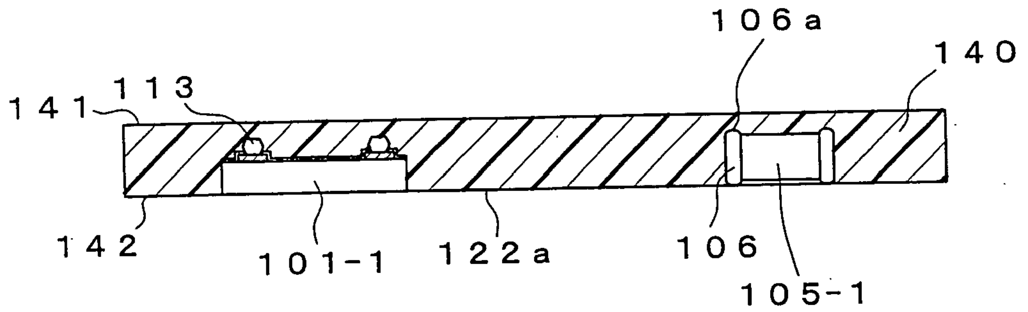

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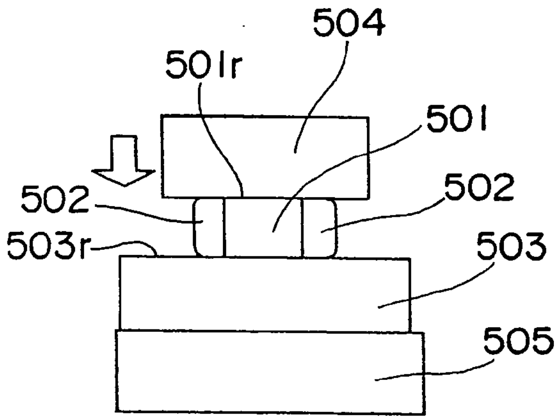

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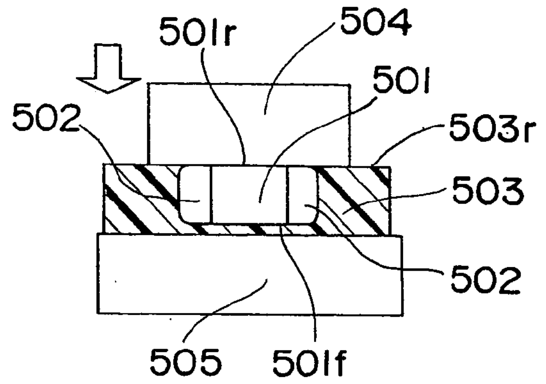

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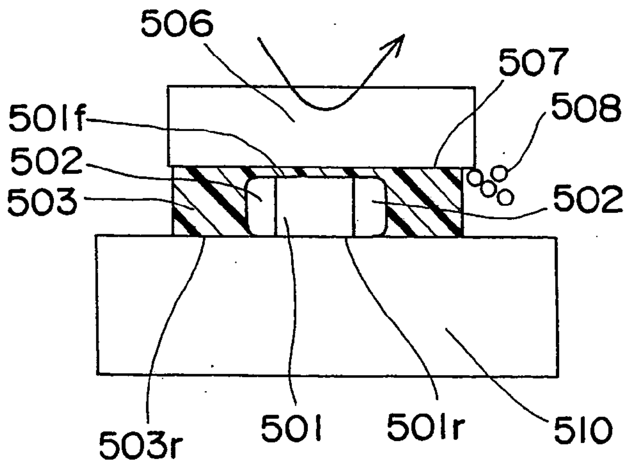

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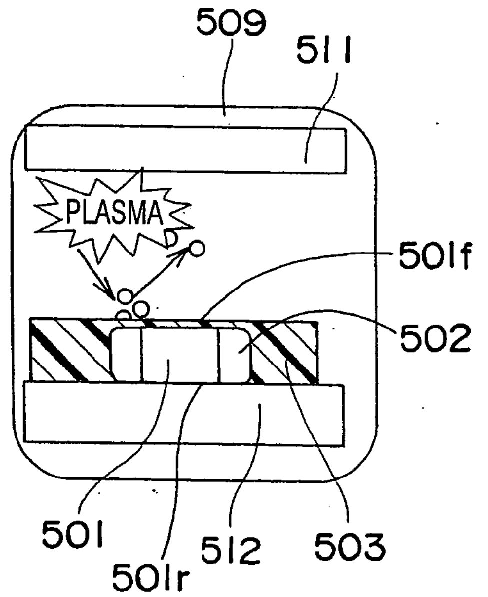

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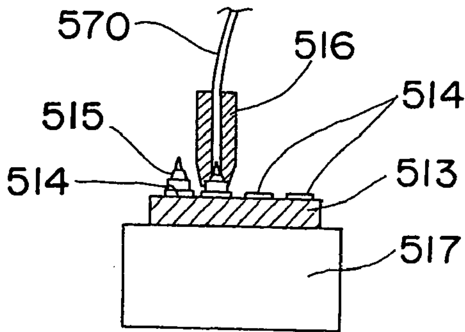

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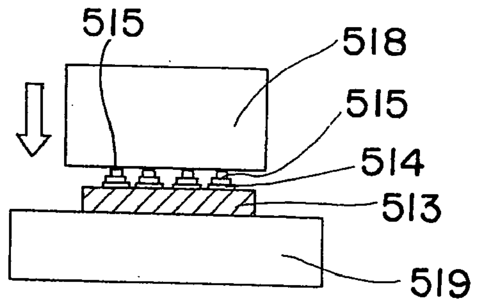

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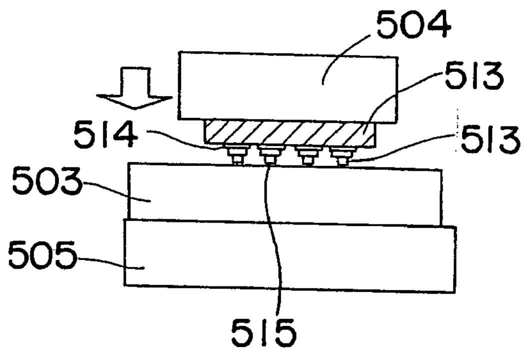

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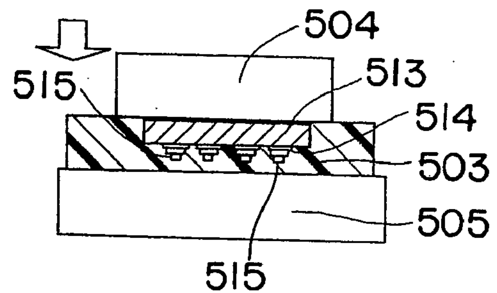

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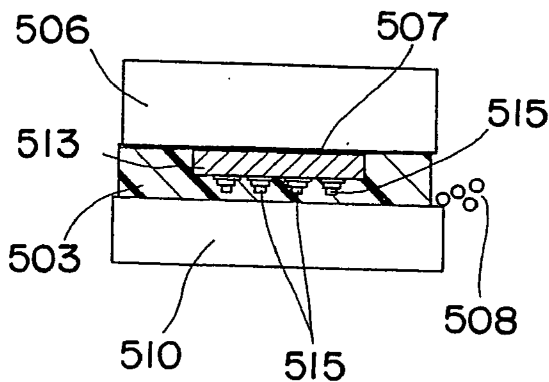

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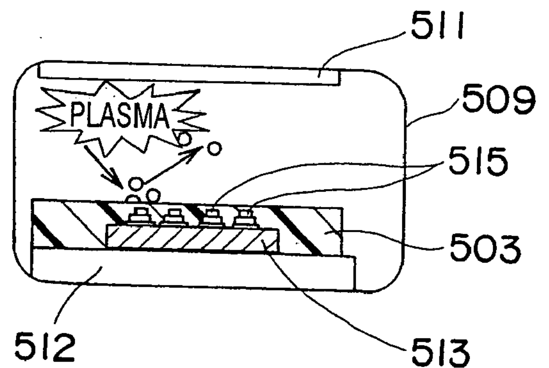

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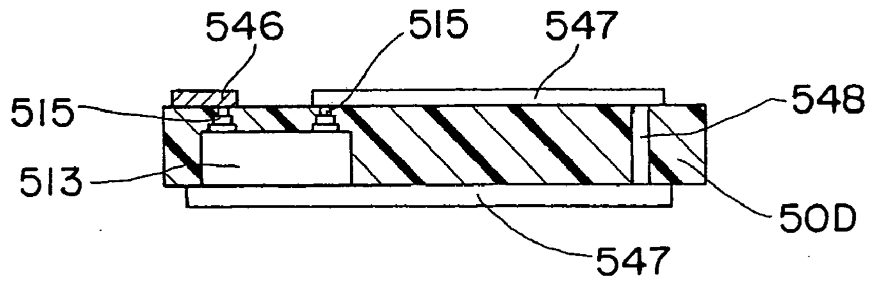


Fig.33B

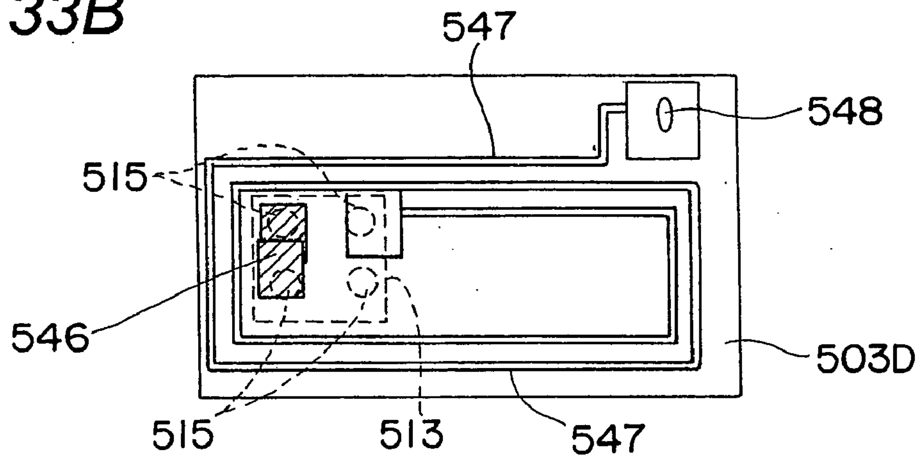


Fig.37 PRIOR ART

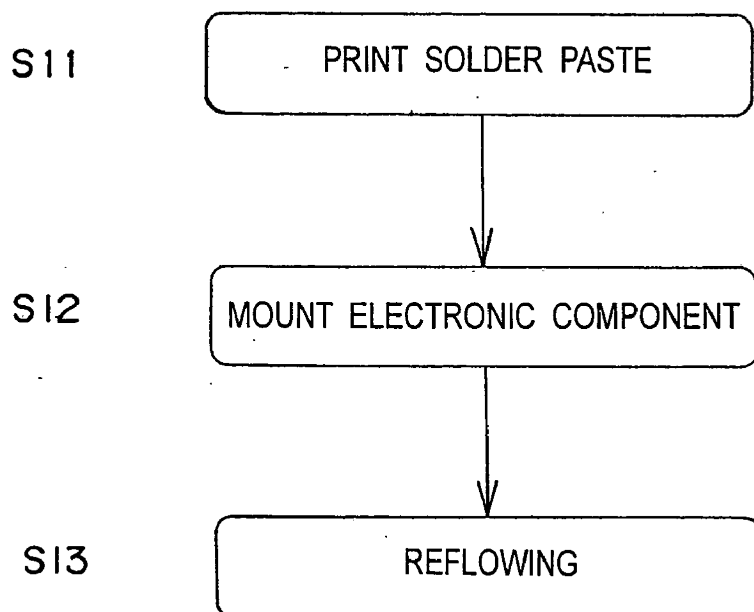
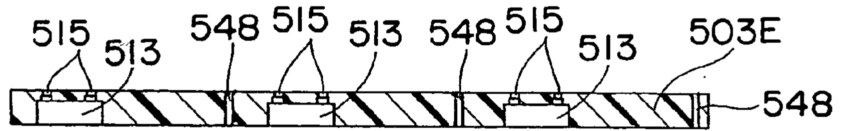


Fig.34A



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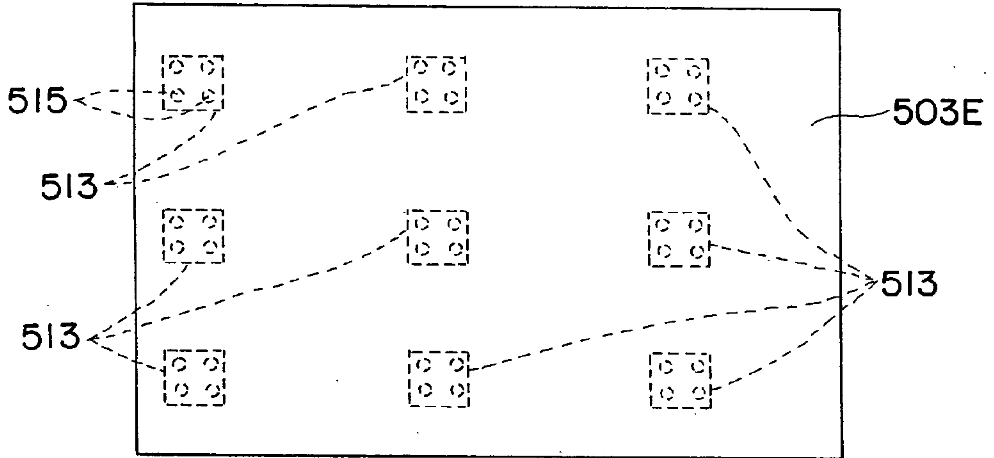

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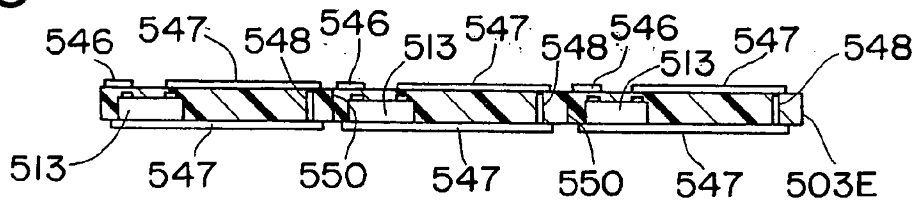

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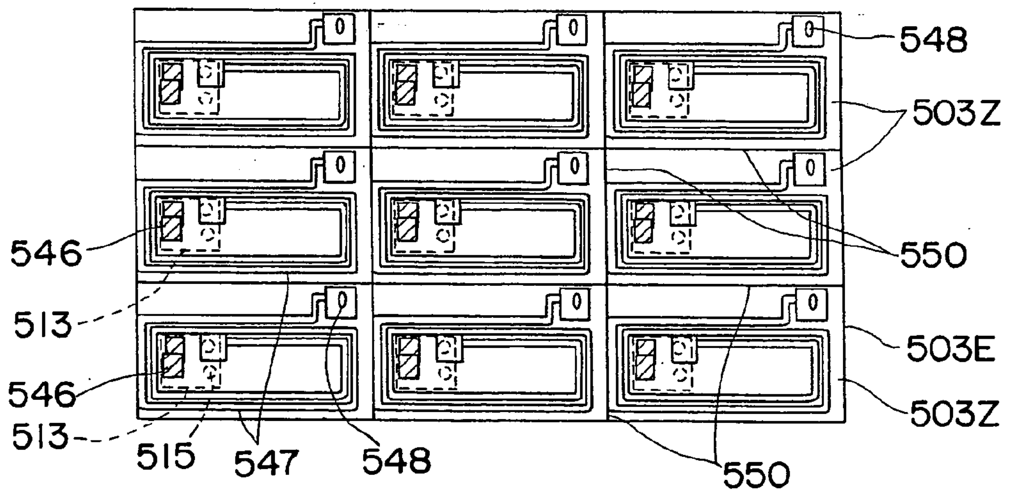

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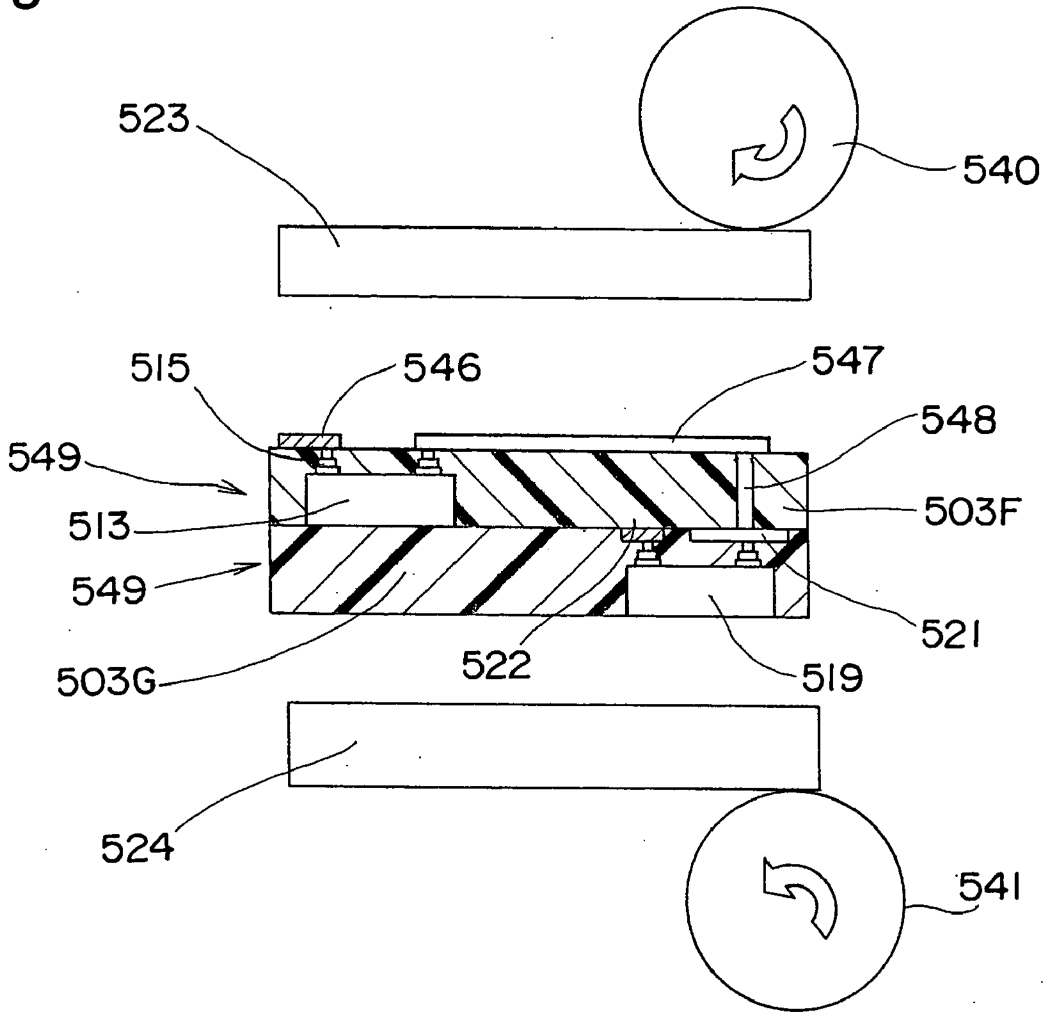

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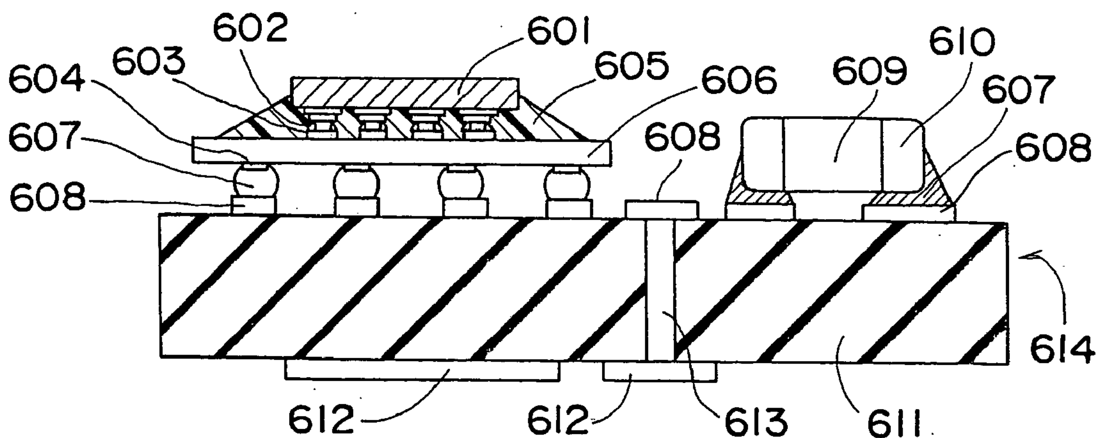

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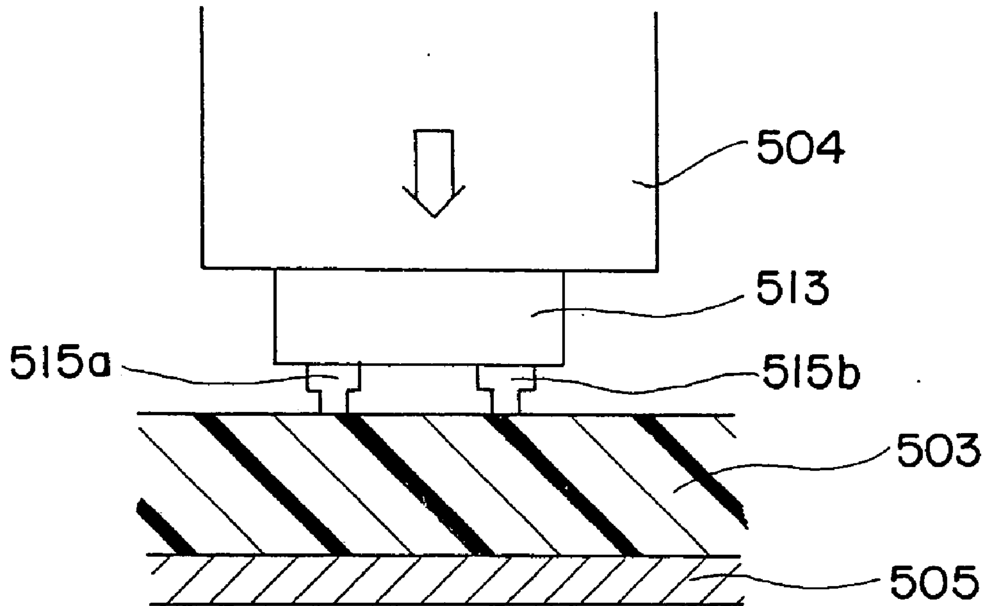

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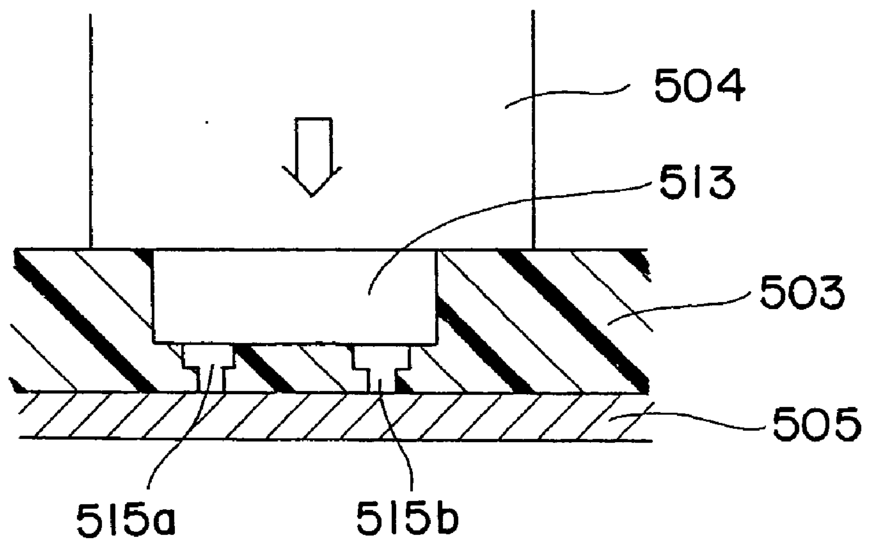

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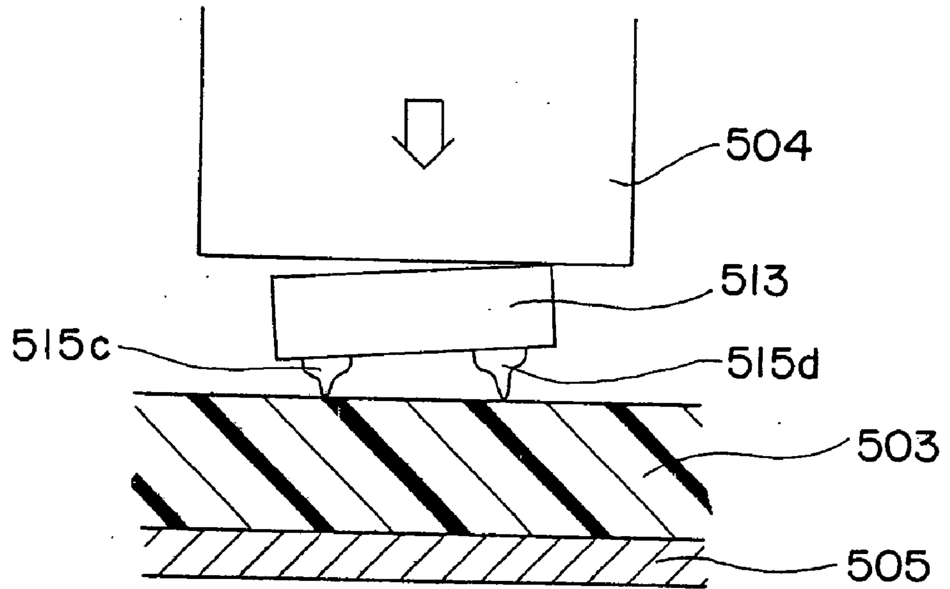

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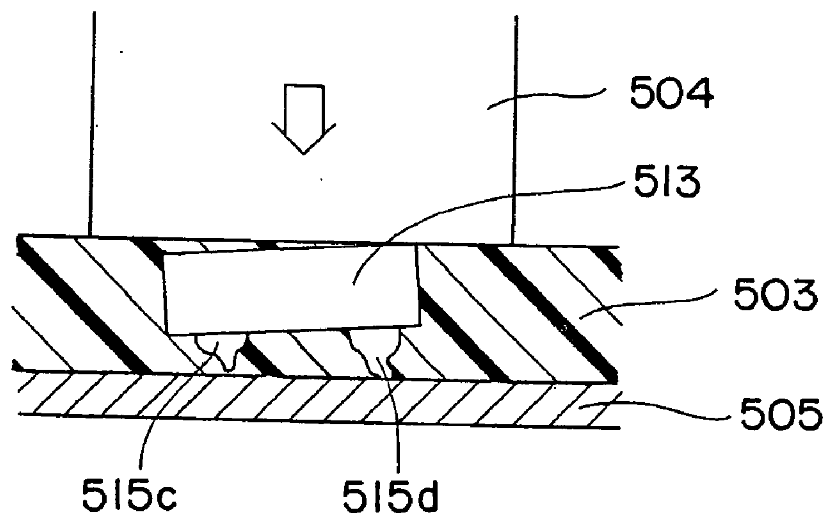

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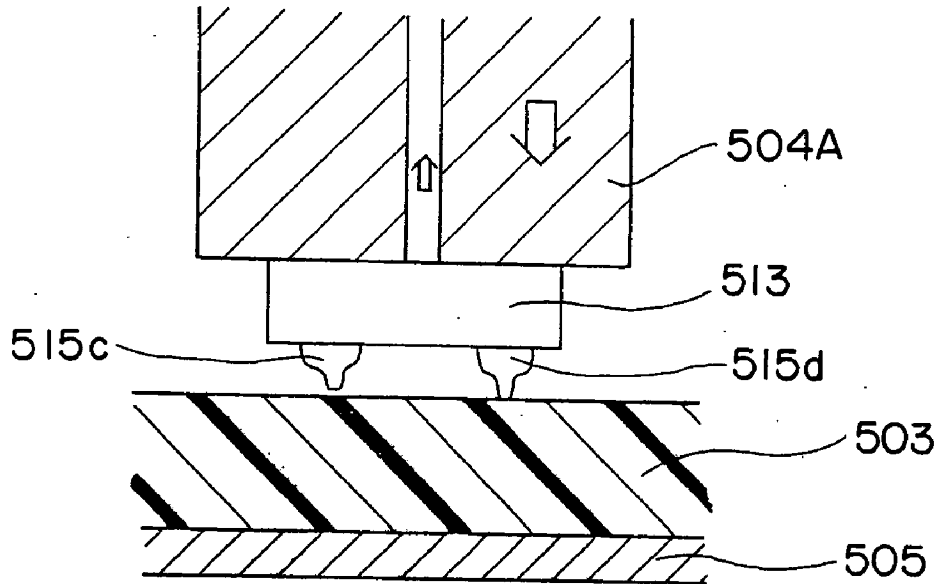

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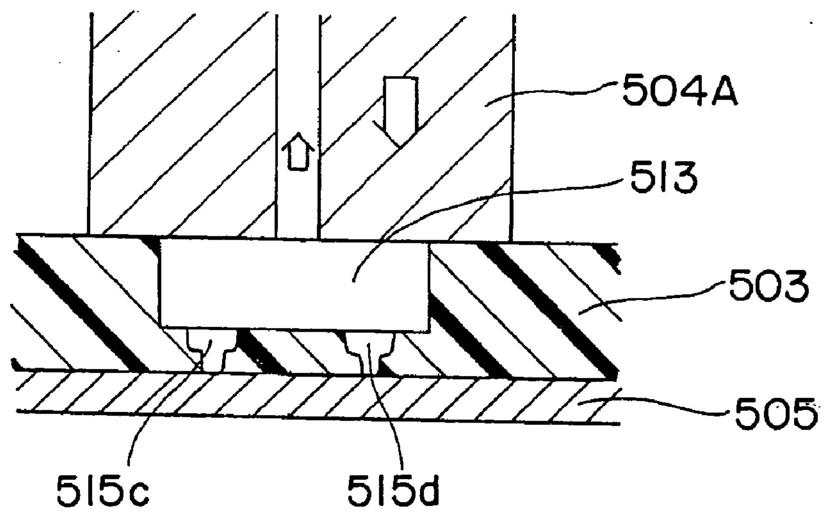

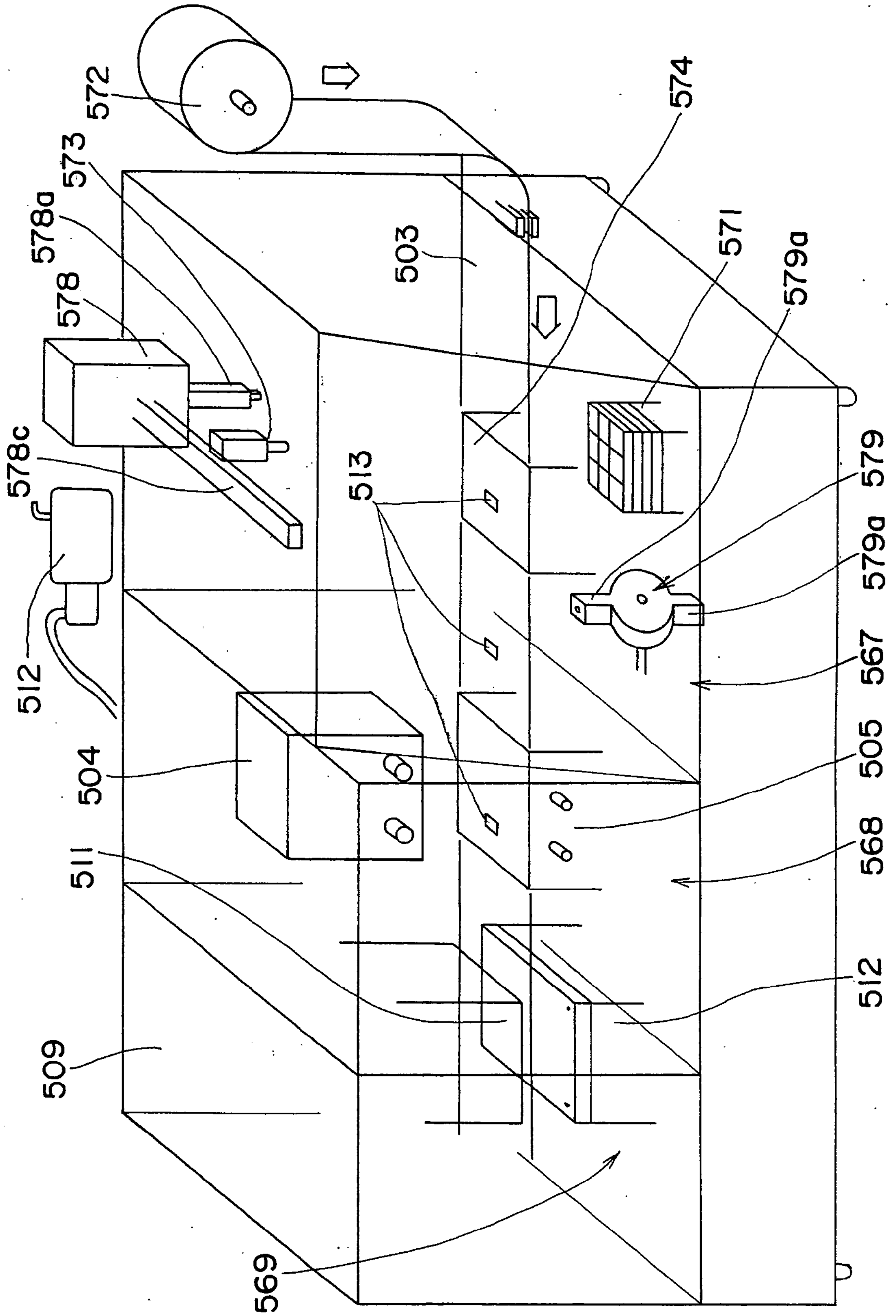

Fig.41
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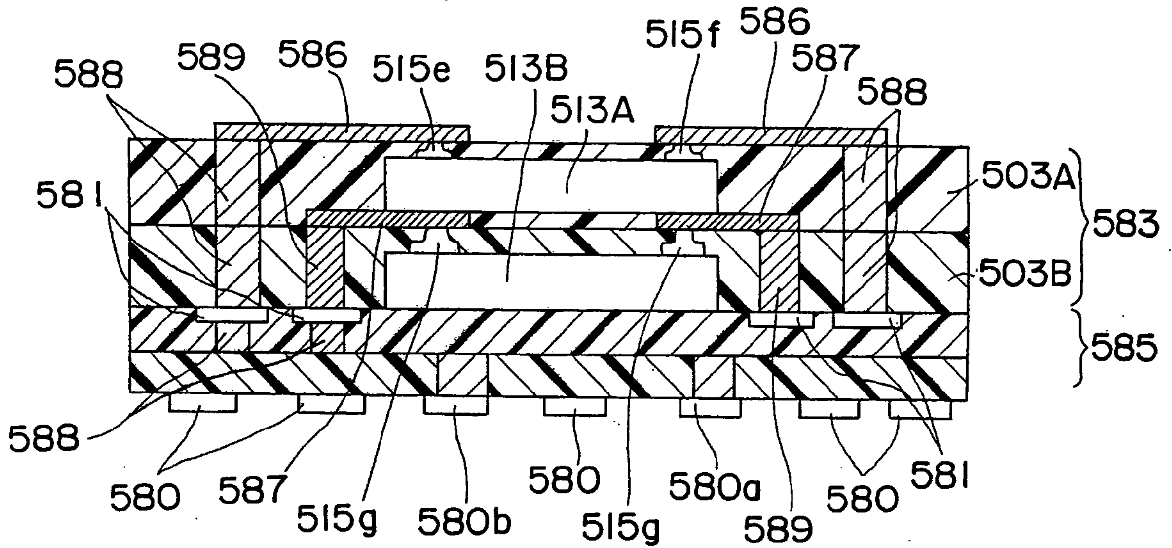
Fig. 42



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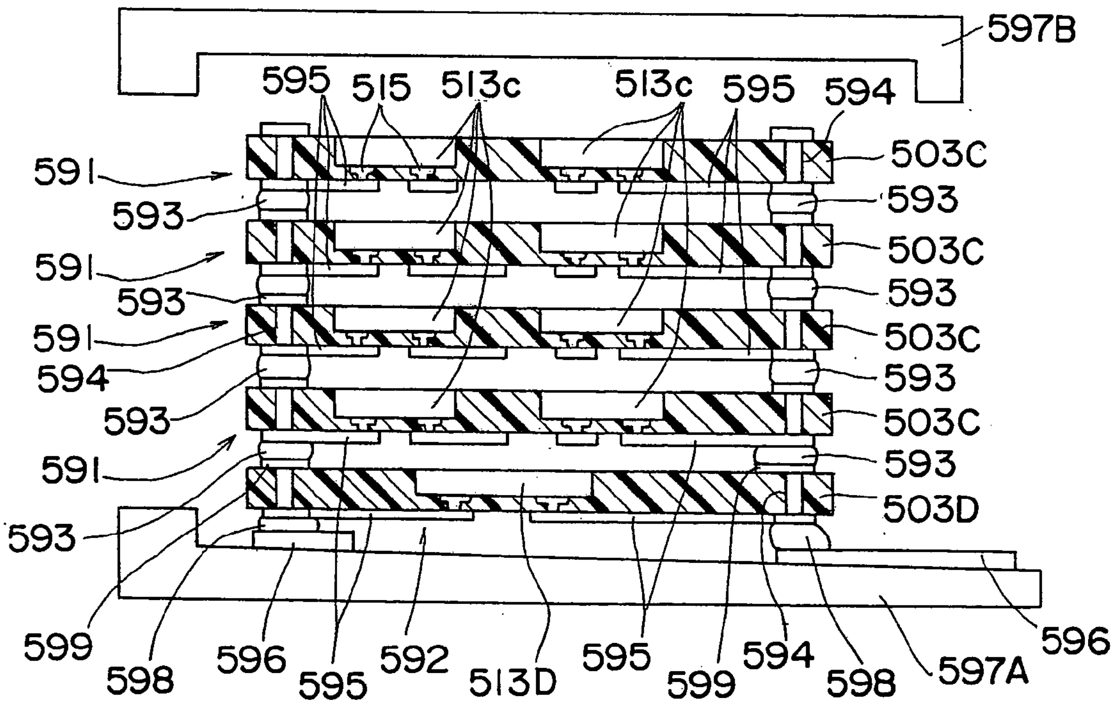

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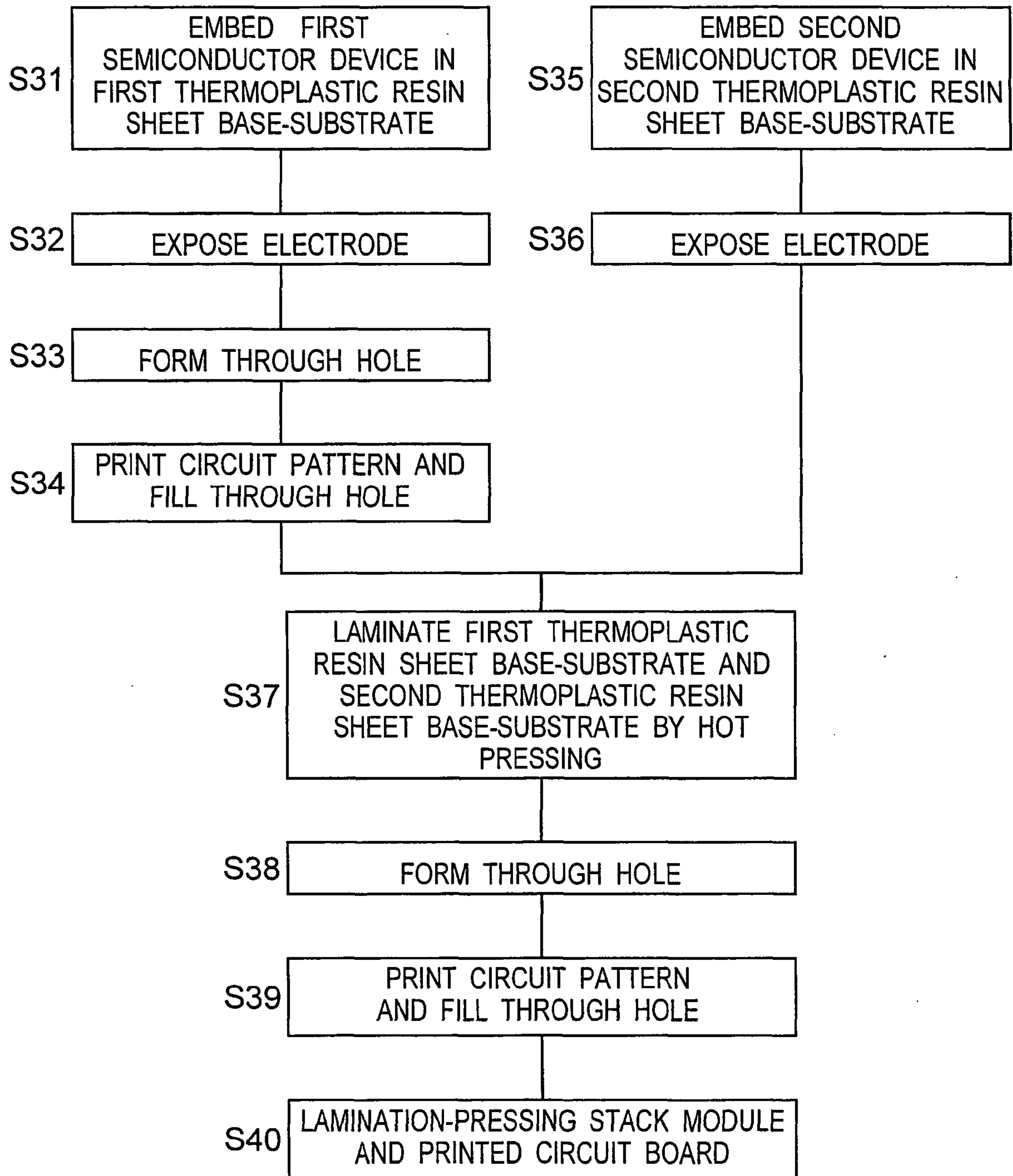

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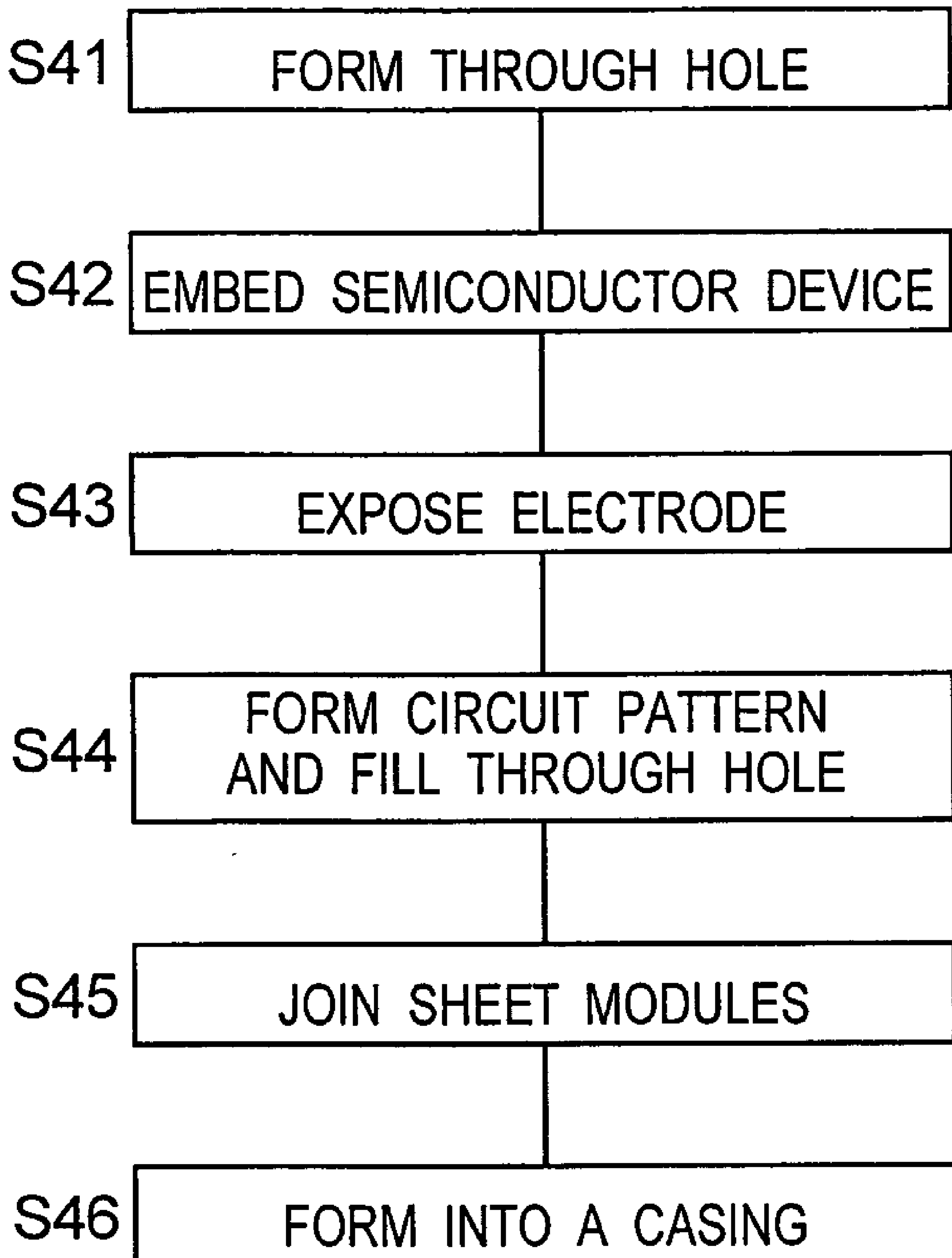

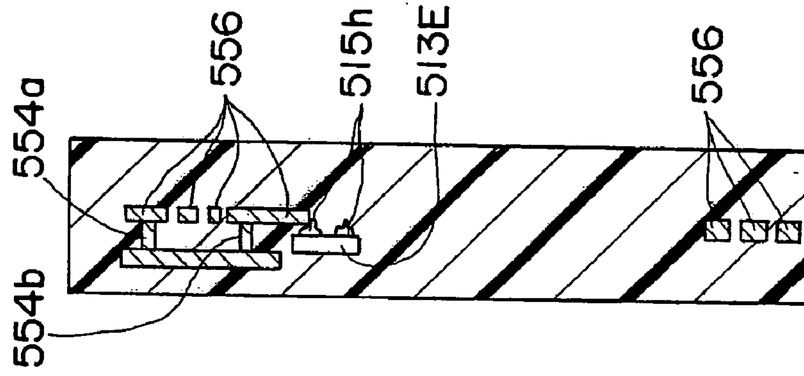
Fig.46C
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513E
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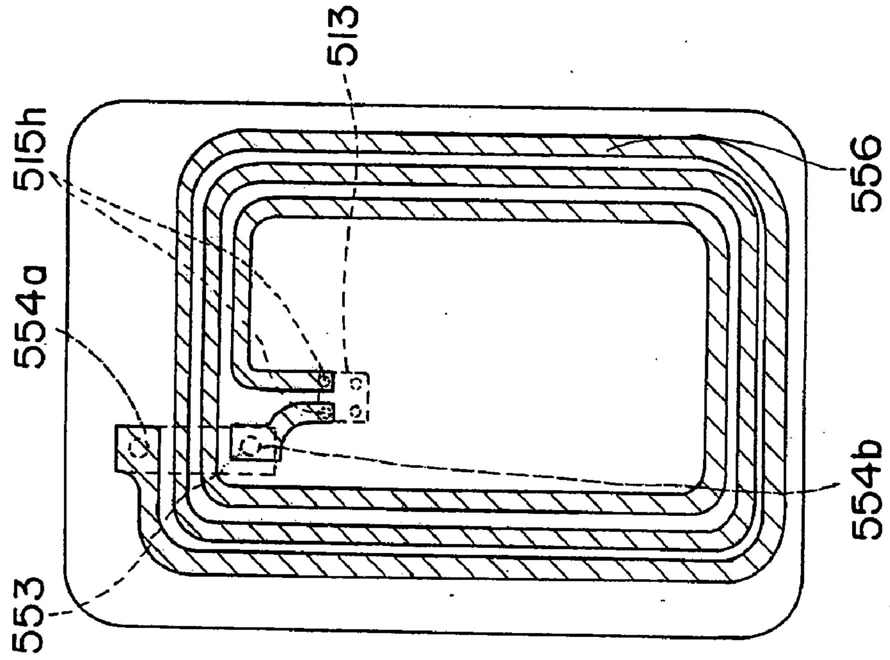
554b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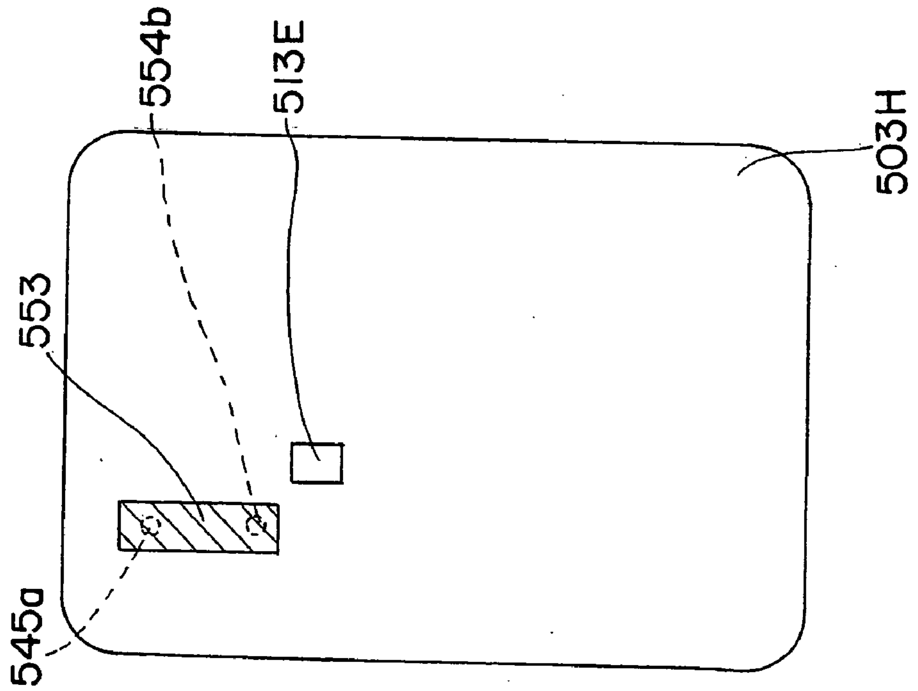
Fig.46A
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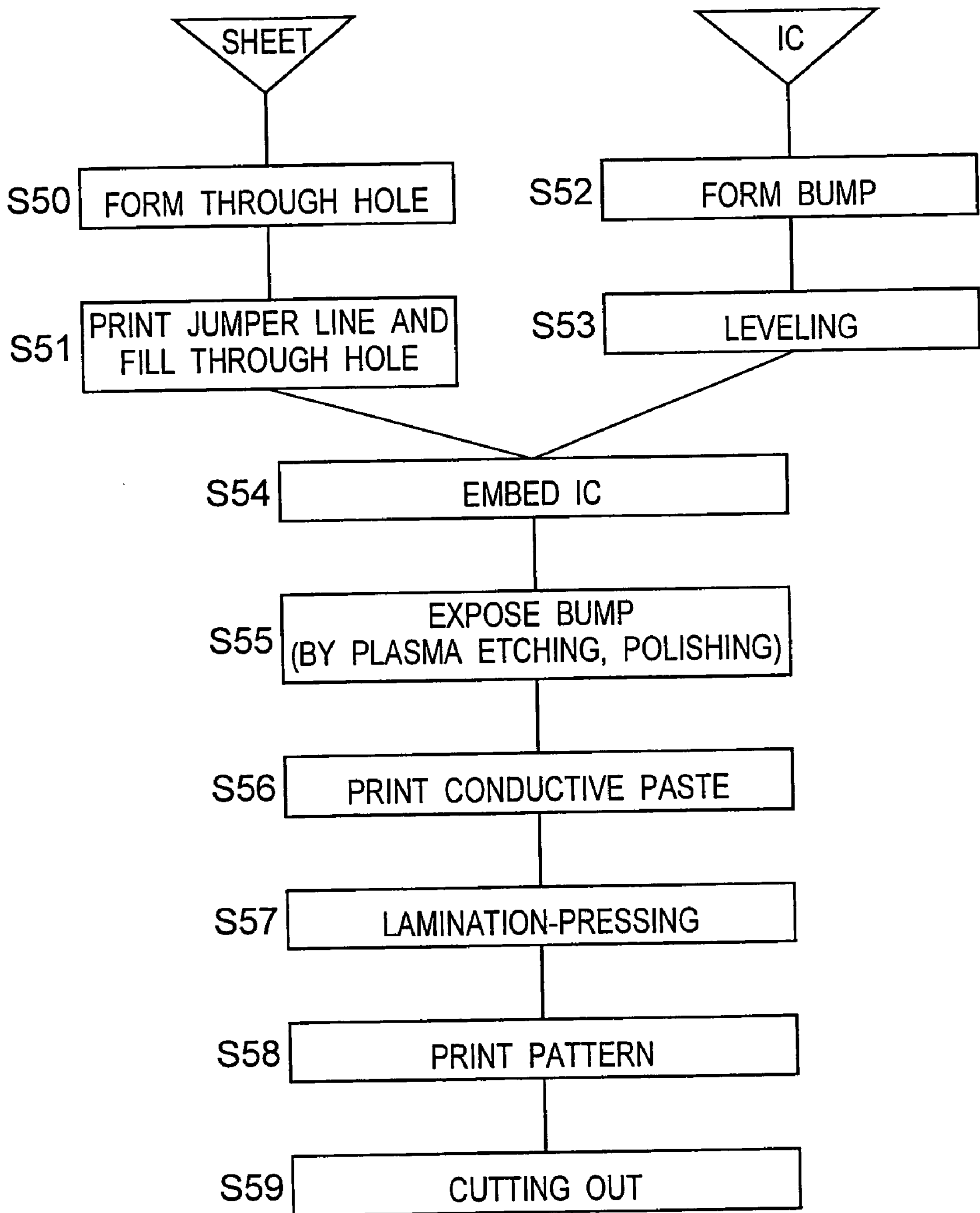
513E
503H
545a

Fig.47



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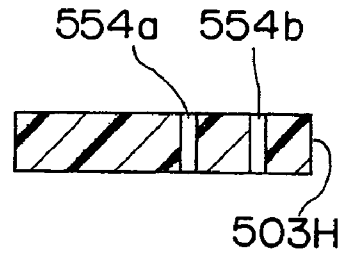

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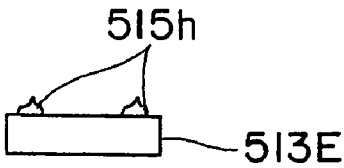

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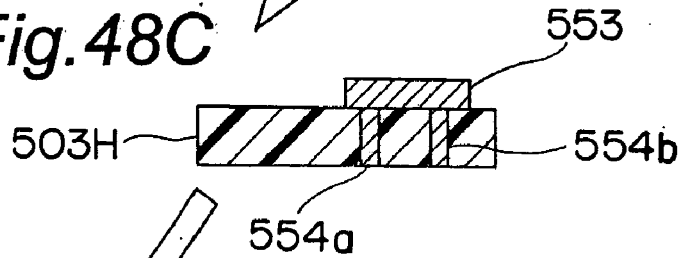


Fig.48D

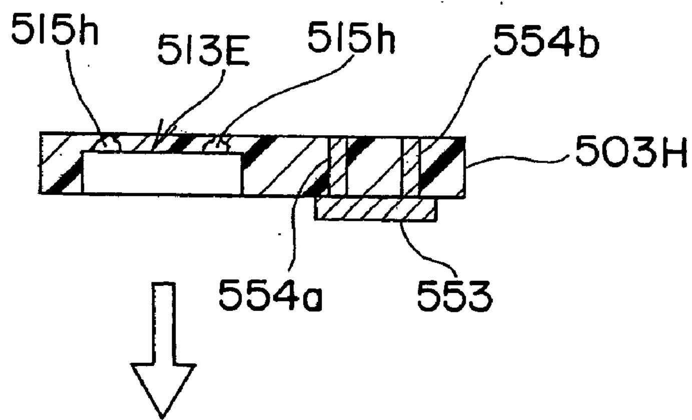


Fig. 49E

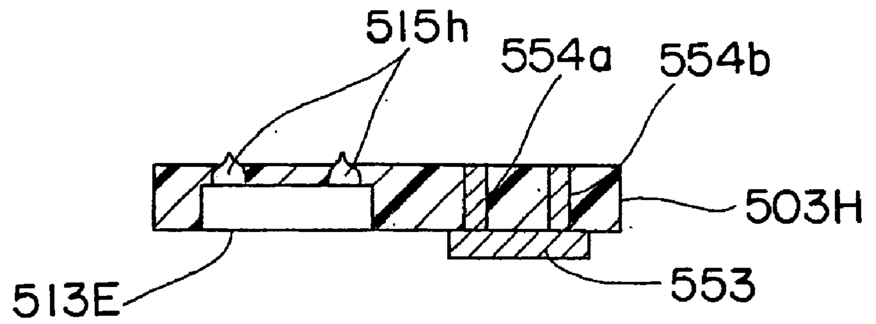


Fig. 49F

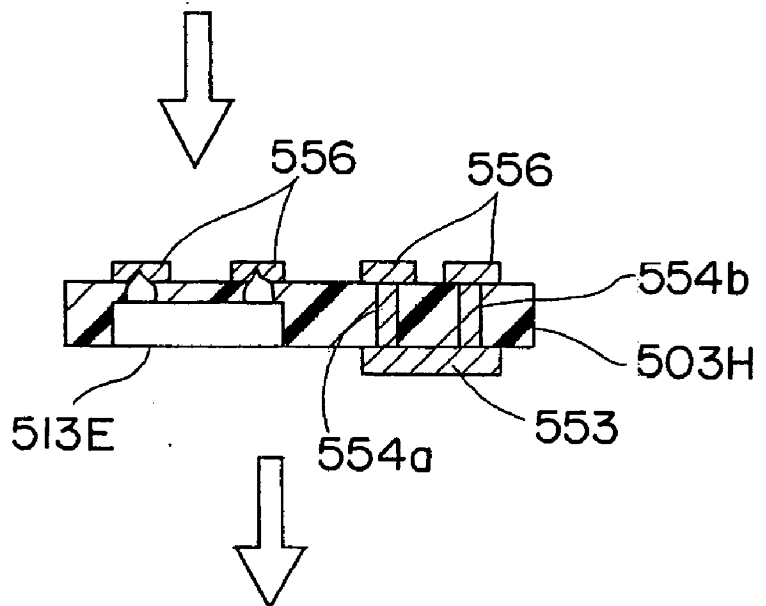


Fig. 49G

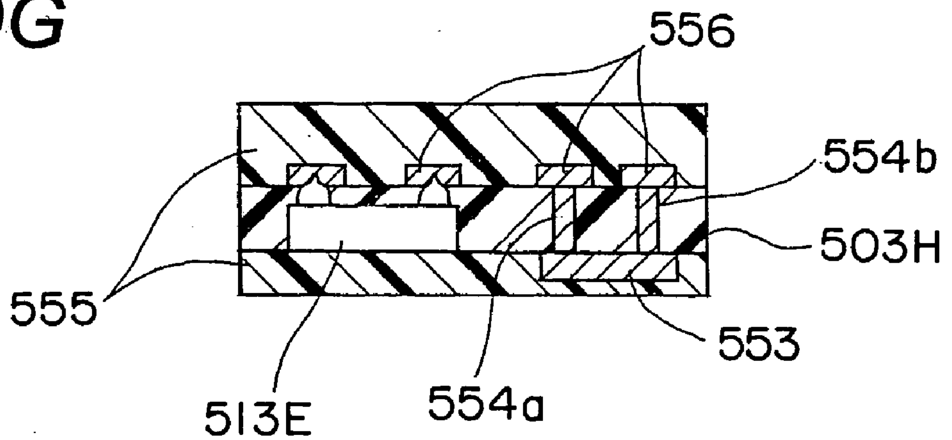


Fig. 50 PRIOR ART

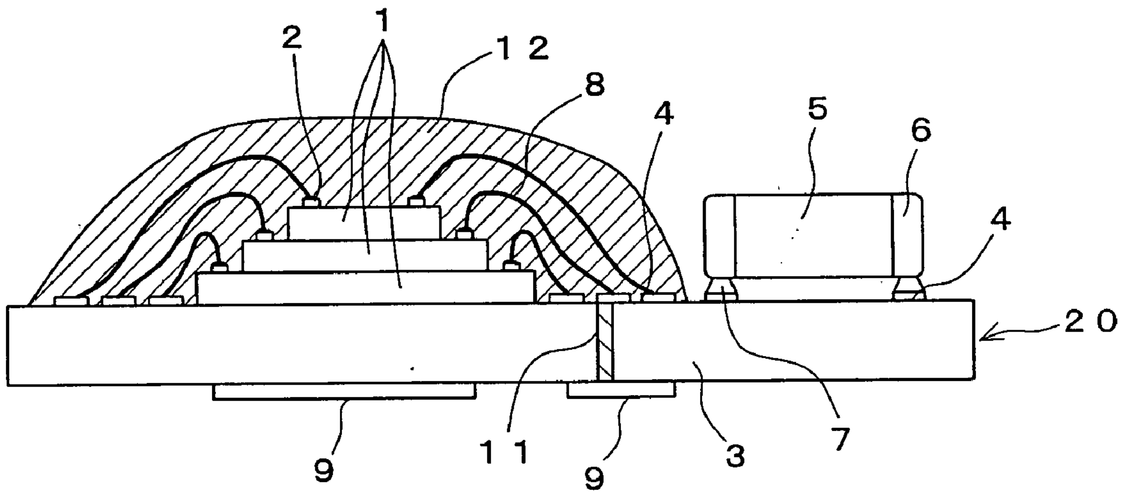
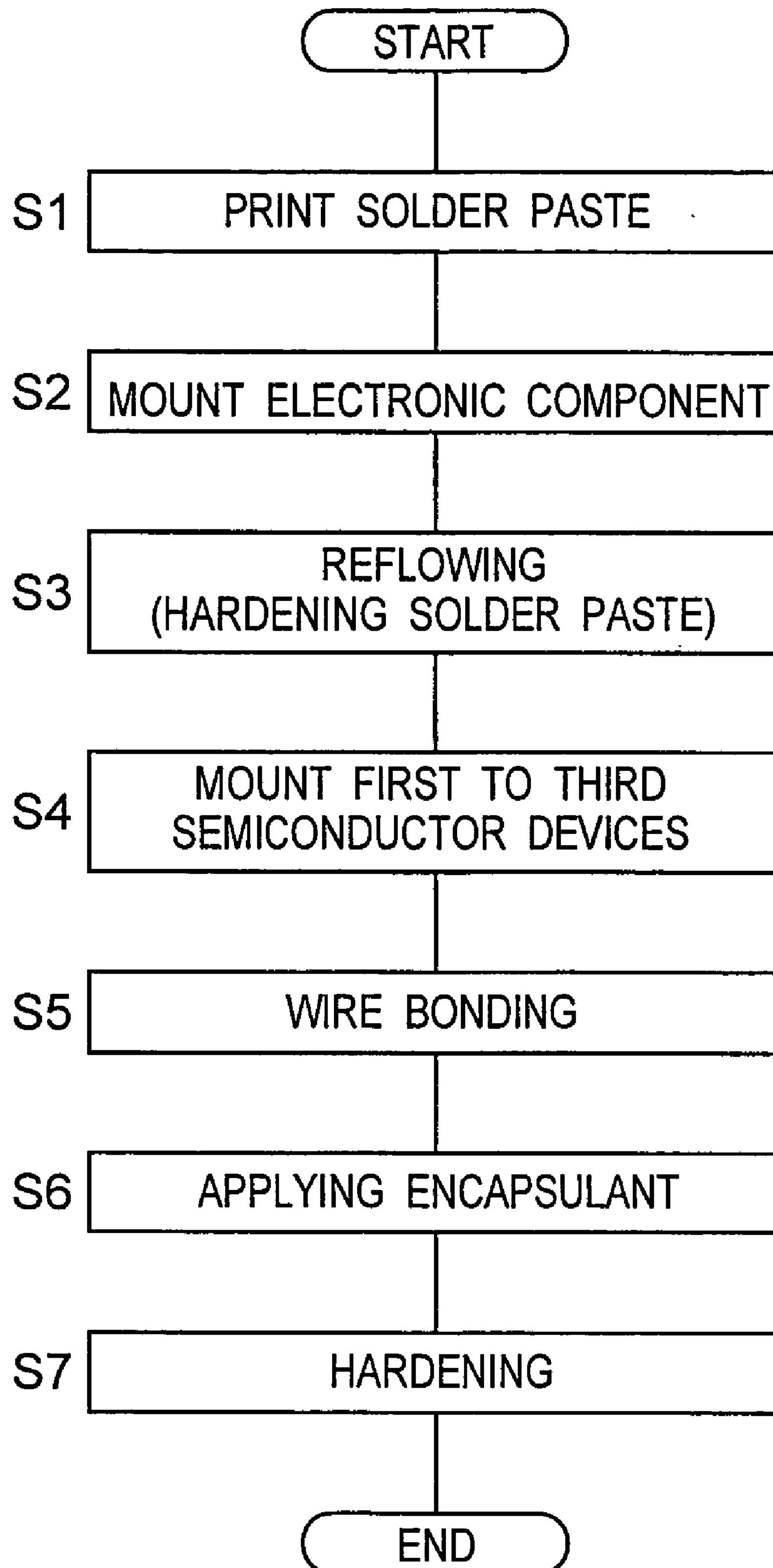


Fig.51 PRIOR ART



METHOD AND APPARATUS FOR MANUFACTURING ELECTRONIC COMPONENT-MOUNTED COMPONENT, AND ELECTRONIC COMPONENT-MOUNTED COMPONENT

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a method and an apparatus for manufacturing an electronic component-mounted component with electronic components such as IC chips mounted on a substrate, and to an electronic component-mounted component manufactured by the method for manufacturing an electronic component-mounted component. Examples of the electronic component-mounted component include: MCM (Multi Chip Module) with a plurality of semiconductor chips and capacitors as well as passive components such as resistors being mounted on one carrier substrate; stack IC modules with a plurality of memory chips stacked in multiple stages; and memory cards.

[0002] Following description discusses a conventional method for manufacturing an electronic component-mounted component with reference to **FIG. 50** and **FIG. 51**.

[0003] Conventionally, in the MCM with the plurality of semiconductor devices and electronic components such as the passive components being mounted thereon, the stack IC modules with the plurality of memory chips stacked in multiple stages, and the memory modules, there is adopted a method for electrically connecting the semiconductor devices to a carrier substrate by wire-bonding method for multilayering. Also, the electronic components are mounted by a method in which solder paste is printed on a specified circuit pattern of the carrier substrate and reflowed.

[0004] As shown in **FIG. 50, a** plurality of semiconductor devices **1**, more specifically, three semiconductor devices **1** in this example, provided in a conventional MCM **20** are laminated on a carrier substrate **3**, and electrically connected to electrodes **4** of a specified circuit pattern formed on the carrier substrate **3** via wires **8** made of gold, copper, aluminum, or the like formed by wire bonding method. Reference numeral **12** denotes an encapsulant for protecting the semiconductor devices **1** including the wires **8**. As for an electronic component **5**, the specified electrodes **4** on the carrier substrate **3** are connected to electrodes **6** of the electronic component **5** via solder paste **7**. It is noted that reference numeral **9** denotes external electrode terminals for establishing electric connection between an unshown mother board and the MCM **20**. The external electrode terminals **9** are not necessary if the MCM **20** is a module for fulfilling functions of a product as a single unit. Reference numeral **11** is a through hole for obtaining electric conduction between a circuit patter on the mounting face side of the carrier substrate **3** and the external electrode terminal **9**.

[0005] The manufacturing process thereof is structured such as shown in **FIG. 51**, that first in the step (referred to as "S" in the drawing) **1**, solder paste is printed on specified electrodes **4** on a carrier substrate **3**. The solder paste **7** is printed generally by screen printing method. Next, in the step **2**, an electronic component **5** is positioned and mounted on the solder paste **7** formed by the printing. Next, in the step **3**, the carrier substrate **3** with the electronic component **5** mounted thereon is put in a reflow furnace so that the solder paste **7** is melted and then hardened. Next, in the step **4**, semiconductor devices **1** are stacked along the thickness direction of the carrier substrate **3**. Though not shown in the drawing, some silver paste is generally used to join the semiconductor device **1** and the carrier substrate **3**, as well as to join each semiconductor device **1**. Next in the step **5**, each electrode **2** of the semiconductor device **1** is electrically connected to the specified electrode **4** on the carrier substrate **3** by wire bonding method with use of a metal wire **8** made of gold, copper, solder and the like. Next in the step **6**, encapsulant **12** is applied for protecting the semiconductor device **1**. Next in the step **7**, the carrier substrate **3** with the encapsulant **12** applied thereto is put in a batch type furnace for hardening the encapsulant **12**. Thus, the MCM **20** as an electronic component-mounted component is manufactured.

[0006] However, the above-described conventional method and apparatus for manufacturing an electronic component-mounted component, as well as MCM, memory modules and the like as the electronic component-mounted components manufactured by the above manufacturing method of an electronic component-mounted component have following issues in terms of their structure.

[0007] Semiconductor components such as semiconductor devices **1** are stacked on the carrier substrate **3**, so that the height of an electronic component-mounted component in thickness direction is increased, which makes it impossible to satisfy recent product needs of reduced thickness.

[0008] Also, since the semiconductor devices **1** are stacked up and each semiconductor device **1** is electrically connected by wire bonding, each of the electrodes **2** needs to be disposed in the periphery of the semiconductor device **1**. Consequently, in stacking up the semiconductor devices **1** as shown in the drawing, it is necessary to use semiconductor devices whose plane sizes are smaller in sequence, and therefore sizes of the usable semiconductor devices are limited. In other words, in the case of a semiconductor device so called an area pad where the electrodes **2** are disposed in a portion other than the external layer portion of the semiconductor device **1**, stacking is not possible.

[0009] The present invention is intended to solve the above issues, and therefore it is an object of the present invention to provide a method and an apparatus for manufacturing an electronic component-mounted component enabling reduction of a thickness and having less restriction of usable electronic components, and an electronic component-mounted component manufactured by the method for manufacturing an electronic component-mounted component.

SUMMARY OF THE INVENTION

[0010] In order to accomplish the above object, the present invention is structured as follows.

[0011] According to a first aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component, comprising of:

> [0012] inserting a first electronic component in a base substrate;
>
> [0013] forming a first circuit patterns, which are electrically connected to a plurality of electrodes of the inserted first electronic component, on a circuit formation face of the base substrate and then estab-

lishing electrically connecting between each of the electrodes and the first circuit pattern; and then

[0014] mounting a second electronic component on the first circuit patterns of the base substrate.

[0015] According to a second aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the first aspect,

[0016] wherein the first electronic component is inserted in the base substrate so that each of the electrodes of the first electronic component is exposed from the circuit formation face of the base substrate.

[0017] According to a third aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the first aspect, further comprising of: after inserting the first electronic component in the base substrate and forming the first circuit patterns and before mounting the second electronic component, performing lamination processing for disposing an insulating protection sheet on an opposite face side opposed to the circuit formation face of the base substrate.

[0018] According to a fourth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the first aspect, further comprising of superposing the base substrate and a first substrate, which has third circuit patterns and fourth circuit patterns opposed to each other and has first substrate through holes having conductors inside thereof for electrically connecting the third circuit patterns and the fourth circuit patterns, in thickness direction of the base substrate and the first substrate, so that the fourth circuit patterns of the first substrate are electrically connected to a plurality of electrodes of the second electronic component mounted on the base substrate.

[0019] According to a fifth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the first aspect, wherein the electric connection between each of the electrodes of the first electronic component and the first circuit patterns is established so that the first circuit patterns are also electrically connected to conductive through-holes which are formed to penetrate through the base substrate in its thickness direction and that have conductors inside thereof.

[0020] According to a sixth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the fifth aspect, further comprising of:

[0021] superposing the base substrate with the first electronic component inserted therein and the first circuit patterns formed thereon and a second substrate, which has fifth circuit patterns and sixth circuit patterns opposed to each other and has second substrate through holes for electrically connecting the fifth circuit patterns and the sixth circuit patterns, in thickness direction of the base substrate and the second substrate, so that the sixth circuit patterns of the second substrate are electrically connected to the through holes of the base substrate; and then

[0022] mounting a third electronic component on the fifth circuit patterns.

[0023] According to a seventh aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the fifth aspect, wherein the electric connection between each of the electrodes of the first electronic component and the first circuit patterns is established so that the first circuit patterns are also electrically connected, via the through holes, to second circuit patterns which are formed on an opposite face side opposed to the circuit formation face and which are electrically connected to the through holes.

[0024] According to an eighth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the seventh aspect, further comprising of mounting a third electronic component on the second circuit patterns.

[0025] According to a ninth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the sixth aspect, further comprising of: stacking a plurality of the base substrates with the first electronic component inserted therein and the first circuit patterns are formed thereon; and superposing the stacked base substrates and the second substrate.

[0026] According to a tenth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component, comprising of:

[0027] inserting a first electronic component in a base substrate;

[0028] forming first circuit patterns, which are electrically connected to a plurality of electrodes of the inserted first electronic component, on a circuit formation face of the base substrate for establishing electric connection between each of the electrodes and the first circuit patterns; and then

[0029] superposing the base substrate and a first substrate, which has third circuit patterns and fourth circuit patterns opposed to each other and has first substrate through holes having conductors inside thereof for electrically connecting the third circuit patterns and the fourth circuit patterns, in thickness direction of the base substrate and the first substrate, so that the fourth circuit patterns of the first substrate are electrically connected to the first circuit patterns of the base substrate.

[0030] According to an eleventh aspect of the present invention, there is provided a method for manufacturing an is electronic component-mounted component as defined in the tenth aspect,

[0031] wherein the first electronic component is inserted in the base substrate so that each of the electrodes of the first electronic component is exposed from the circuit formation face of the base substrate.

[0032] According to a twelfth aspect of the present invention, there is provided a method for manufacturing an

electronic component-mounted component as defined in the tenth aspect, further comprising of:

[0033] superposing the base substrate with the first electronic component inserted therein and the first circuit patterns formed thereon and the first substrate and then establishing electrically connecting between the fourth circuit patterns and the first circuit patterns; and then

[0034] mounting a second electronic component on the third circuit patterns.

[0035] According to a thirteenth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the tenth aspect, further comprising of mounting a second electronic component on the third circuit patterns prior to establishing the electric connection between the fourth circuit patterns of the base substrate and the first circuit patterns of the first substrate.

[0036] According to a fourteenth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the tenth aspect, further comprising of:

[0037] after inserting the first electronic component in the base substrate and forming the first circuit patterns, performing lamination processing for disposing a insulating protection sheet on an opposite face opposed to the circuit formation face of the base substrate; and

[0038] establishing electric connection between the first circuit patterns of the lamination-processed base substrate and the fourth circuit patterns.

[0039] According to a fifteenth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the tenth aspect, wherein the electric connection between each of the electrodes of the first electronic component and the first circuit patterns is established so that the first circuit patterns are also electrically connected to conductive through-holes which are formed to penetrate through the base substrate in its thickness direction and that have conductors inside thereof.

[0040] According to a sixteenth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the fifteenth aspect, further comprising of:

[0041] superposing the base substrate with the first electronic component inserted therein and the first circuit patterns formed thereon and a second substrate, which has fifth circuit patterns and sixth circuit patterns opposed to each other and has second substrate through holes for electrically connecting the fifth circuit patterns and the sixth circuit patterns, in thickness direction of the base substrate and the second substrate, so that the sixth circuit patterns of the second substrate are electrically connected to the through holes of the base substrate; and then

[0042] mounting a third electronic component on the fifth circuit patterns.

[0043] According to a seventeenth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the tenth aspect, wherein the base substrate and the first substrate is superposed via binder.

[0044] According to an eighteenth aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the sixteenth aspect, wherein the first substrate and the second substrate are superposed on the base substrate via binder.

[0045] According to a nineteenth aspect of the present invention, there is provided an electronic component-mounted component manufactured by the method for manufacturing an electronic component-mounted component as defined in the first aspect.

[0046] According to a twentieth(20th) aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the first aspect, further comprising of, after inserting the first electronic component in the base substrate, exposing each of the electrodes of the inserted first electronic component from a surface of the base substrate by either one of or both polishing processing and plasma discharge processing.

[0047] According to a 21st aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the 20th aspect, further comprising of:

[0048] before inserting the first electronic component in the base substrate, forming a protruding electrode on each of a plurality of electrodes of a semiconductor device as the first electronic component; then

[0049] inserting the semiconductor device in the base substrate with each of the protruding electrodes leveled to have a uniform height or without leveling operation; and

[0050] exposing each of the protruding electrodes from a surface of the base substrate.

[0051] According to a 22nd aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the 20th aspect, further comprising of, after exposing each of the electrodes of the first electronic component from the surface of the base substrate, forming a conductive film on each of the exposed electrodes instead of forming the first circuit patterns and mounting the second electronic component, for forming circuit components.

[0052] According to a 23rd aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the 20th aspect, further comprising of:

[0053] after exposing each of the electrodes of the first electronic component from the surface of the base substrate, printing solder paste or conductive adhesive on each of the exposed electrodes; and then

[0054] heat-hardening the electrodes in a high-temperature furnace or in a high-temperature stage for forming the first circuit patterns.

[**0055**] According to a 24th aspect of the present invention, there is provided a method for manufacturing an electronic component-mounted component as defined in the 20th aspect, further comprising of:

[**0056**] collectively inserting a plurality of the first electronic components in the base substrate;

[**0057**] exposing each of the electrodes of each of the first electronic components from the surface of the base substrate; and

[**0058**] cutting the base substrate into pieces so that each of the first electronic components is separated from each other.

[**0059**] According to a 25th aspect of the present invention, there is provided a manufacturing method of an electronic component-mounted component for manufacturing a multi-layer-laminated electronic component-mounted component comprising of: after manufacturing the electronic component-mounted component by the method for manufacturing the electronic component-mounted component as defined in the 22nd aspect, superposing on one face or both faces of the electronic component-mounted component, a plurality of the electronic component-mounted components or the base substrates in thickness direction thereof; and disposing a insulating protection sheet on both superposed front and back faces.

[**0060**] According to a 26th aspect of the present invention, there is provided an electronic component-mounted component manufactured by the method for manufacturing an electronic component-mounted component as defined in the 20th aspect.

[**0061**] According to a 27th aspect of the present invention, there is provided an electronic component-mounted component, comprising:

[**0062**] a base substrate; and

[**0063**] an electronic component inserted in the base substrate with a plurality of electrodes being exposed from a surface of the base substrate by either one of or both polishing processing and plasma discharge processing.

[**0064**] According to a 28th aspect of the present invention, there is provided the electronic component-mounted component as defined in the 27th aspect, further comprising a circuit component formed by forming a conductive film on each of the electrodes exposed from the surface of the base substrate.

[**0065**] According to a 29th aspect of the present invention, there is provided an apparatus for manufacturing an electronic component-mounted component, comprising:

[**0066**] an electronic component feeding apparatus for feeding a base substrate and an electronic component;

[**0067**] a vertical inverting apparatus for sucking the electronic component and then inverting the electronic component vertically;

[**0068**] an electronic component mounting apparatus for mounting the electronic component on the base substrate;

[**0069**] an electronic component inserting apparatus for inserting the electronic component in the base substrate; and

[**0070**] an electrode exposing apparatus for exposing each of the electrodes from a surface of the base substrate by using either one of or both plasma discharge processing and polishing processing.

BRIEF DESCRIPTION OF THE DRAWINGS

[**0071**] These and other objects and features of the present invention will become clear from the following description taken in conjunction with the preferred embodiments thereof with reference to the accompanying drawings, in which:

[**0072**] **FIG. 1** is a view showing an electronic component-mounted component in an embodiment of the present invention;

[**0073**] **FIG. 2** is a view showing a semiconductor device included in the electronic component-mounted component shown in **FIG. 1**;

[**0074**] **FIG. 3** is a view showing a capacitor component included in the electronic component-mounted component shown in **FIG. 1**;

[**0075**] **FIG. 4** is a view of a manufacturing process of the electronic component-mounted component shown in **FIG. 1** for showing a state that first electronic components are placed on a base substrate;

[**0076**] **FIG. 5** is a view of the manufacturing process of the electronic component-mounted component shown in **FIG. 1** for describing an operation of embedding the first electronic components in the base substrate;

[**0077**] **FIG. 6** is a view of the manufacturing process of the electronic component-mounted component shown in **FIG. 1** for showing a state that the first electronic components are embedded in the base substrate;

[**0078**] **FIG. 7** is a views of the manufacturing process of the electronic component-mounted component shown in **FIG. 1** for showing a state that first circuit patterns are formed on the base substrate;

[**0079**] **FIG. 8** is a flowchart showing the manufacturing process of the electronic component-mounted component shown in **FIG. 1**;

[**0080**] **FIG. 9** is a views of the manufacturing process of the electronic component-mounted component shown in **FIG. 1** for showing a state that the other face of the base substrate is lamination-processed;

[**0081**] **FIG. 10** is a view showing a modified example of an apparatus for performing the lamination processing shown in **FIG. 9**;

[**0082**] **FIG. 11** is a view showing a modified example of the lamination processing shown in **FIG. 9**;

[**0083**] **FIG. 12** is a view showing an electronic component-mounted component manufactured by the lamination processing shown in **FIG. 9** and **FIG. 10**;

[**0084**] **FIG. 13** is a view showing an electronic component-mounted component manufactured by the lamination processing shown in **FIG. 11**;

[0085] **FIG. 14** is a view showing an electronic component-mounted component with second electronic components being mounted on the electronic component-mounted component shown in **FIG. 12**;

[0086] **FIG. 15** is a view showing a step of bonding a first substrate on first circuit patterns of the electronic component-mounted component shown in **FIG. 7**;

[0087] **FIG. 16** is a views showing an electronic component-mounted component with the first substrate being bonded to the first circuit patterns of the electronic component-mounted component shown in **FIG. 7**;

[0088] **FIG. 17** is a view showing an electronic component-mounted component with second electronic components being mounted on the electronic component-mounted component shown in **FIG. 16**;

[0089] **FIG. 18** is a view showing a first substrate having second electronic components mounted thereon;

[0090] **FIG. 19** is a view showing an electronic component-mounted component with a first substrate equipped with electronic components being bonded with binder to the first circuit patterns of the electronic component-mounted component shown in **FIG. 7**;

[0091] **FIG. 20** is a view showing an electronic component-mounted component with a first substrate being bonded with binder to the second electronic components of the electronic component-mounted component shown in **FIG. 1**;

[0092] **FIG. 21** is a view showing an electronic component-mounted component with third electronic components being mounted on the electronic component-mounted component shown in **FIG. 20**;

[0093] **FIG. 22** is a view showing an electronic component-mounted component with the other face of the base substrate of the electronic component-mounted component shown in **FIG. 19** being lamination-processed;

[0094] **FIG. 23** is a view showing an electronic component-mounted component with second circuit patterns being formed on the other face of the base substrate of the electronic component-mounted component shown in **FIG. 7**;

[0095] **FIG. 24** is a view showing an electronic component-mounted component with an electronic component being mounted on the first and second circuit patterns of the electronic component-mounted component shown in **FIG. 23**;

[0096] **FIG. 25** is a view showing an electronic component-mounted component with conductive through-holes provided in the base substrate of the electronic component-mounted component shown in **FIG. 1** and further with a second substrate as shown in **FIG. 18** being mounted on the other face of the substrate;

[0097] **FIG. 26** is a view showing an electronic component-mounted component with conductive through-holes provided in the base substrate of the electronic component-mounted component shown in **FIG. 17** and further with a second substrate as shown in **FIG. 18** being mounted on the other face of the substrate;

[0098] **FIG. 27** is a view showing an electronic component-mounted component with conductive through-holes provided in the base substrate of the electronic component-mounted component shown in **FIG. 19** and further with a second substrate as shown in **FIG. 18** being mounted on the other face of the substrate;

[0099] **FIG. 28** is a view showing an electronic component-mounted component formed by laminating a plurality of electronic component-mounted components with conductive through-holes provided in the base substrate of the electronic component-mounted component shown in **FIG. 7**;

[0100] **FIG. 29** is a view showing an electronic component-mounted component formed by mounting second electronic components on the first circuit patterns of the electronic component-mounted component shown in **FIG. 28** and further mounting a second substrate as shown in **FIG. 18** on the other face of the substrate of the electronic component-mounted component;

[0101] **FIG. 30** is a view showing the case where electrodes of a first electronic component embedded in a base substrate are not exposed from the base substrate;

[0102] **FIGS. 31A, 31B, 31**C and **31**D are fragmentary cross sectional views each showing a manufacturing process of a method for manufacturing an electronic component-mounted component according to a ninth embodiment of the present invention;

[0103] **FIGS. 32A, 32B, 32**C, **32**D, **32**E and **32**F are partial cross sectional views each showing the manufacturing process of a method for manufacturing an electronic component-mounted component according to a tenth embodiment of the present invention;

[0104] **FIGS. 33A and 33B** are, respectively, a partial cross sectional view and a plane view each showing an electronic component-mounted component having a thin-film capacitor and a coil on the surface of the base substrate in an eleventh embodiment of the present invention;

[0105] **FIGS. 34A, 34B, 34**C and **34**D are, respectively, a partial cross sectional view, a plane view, a partial cross sectional view, and a plane view of a manufacturing process of an electronic component-mounted component for describing a step of mounting a plurality of electronic components and dividing into pieces per module in a modified example of the eleventh embodiment of the present invention;

[0106] **FIG. 35** is a partial cross sectional view showing a manufacturing process of a method for manufacturing a multilayer-laminated electronic component-mounted component with the electronic component-mounted components being laminated in a twelfth embodiment of the present invention;

[0107] **FIG. 36** is a partial cross sectional view showing a conventional electronic component-mounted component;

[0108] **FIG. 37** is a flowchart showing a manufacturing process of the conventional electronic component-mounted component;

[0109] **FIGS. 38A and 38B** are cross sectional views of a thermoplastic resin sheet base-substrate and others for describing a method for directly embedding a semiconductor

device in the thermoplastic resin sheet base-substrate without leveling protruding electrodes to have a uniform height in another embodiment of the present invention;

[0110] **FIGS. 39A and 39B** are cross sectional views of a thermoplastic resin sheet base-substrate and others for describing a method for directly embedding a semiconductor device in the thermoplastic resin sheet base-substrate without leveling after formation of bumps in still another embodiment of the present invention;

[0111] **FIGS. 40A and 40B** are cross sectional views of a thermoplastic resin sheet base-substrate and others for describing an embedding method without leveling in still another embodiment of the present invention;

[0112] **FIG. 41** is a schematic view showing one example of an apparatus for manufacturing an electronic component-mounted component according to yet another embodiment of the present invention;

[0113] **FIG. 42** is a cross sectional view showing a built-in package module in which a stack module formed by stacking two memory chips is mounted on a printed circuit board in still another embodiment of the present invention;

[0114] **FIG. 43** is a flowchart showing a method for manufacturing a package module of **FIG. 42**;

[0115] **FIG. 44** is a cross sectional view showing a memory card composed of: four layers of sheet modules for memory made of layers of thermoplastic resin sheet base-substrates incorporating two semiconductor devices for memory; and one layer of a sheet module for controller made of a thermoplastic resin sheet base substrate incorporating one semiconductor device for controller in still another embodiment of the present invention;

[0116] **FIG. 45** is a flowchart showing a manufacturing process of the memory card of **FIG. 44**;

[0117] **FIGS. 46A, 46B** and **46**C are, respectively, a top view, a bottom view and a cross sectional view each showing an intermediate layer of a non-contact IC card manufactured by a method for manufacturing a non-contact IC card according to yet another embodiment of the present invention;

[0118] **FIG. 47** is a flowchart showing the method for manufacturing the non-contact IC card;

[0119] **FIGS. 48A, 48B, 48**C and **48**D are process charts each showing the method for manufacturing the non-contact IC card;

[0120] **FIGS. 49E, 49F** and **49**G are process charts each showing the method for manufacturing the non-contact IC card following **FIG. 48D**;

[0121] **FIG. 50** is a view showing a conventional electronic component-mounted component; and

[0122] **FIG. 51** is a flowchart showing the manufacturing process of a conventional electronic component-mounted component.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0123] Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout the accompanying drawings.

[0124] Description will be hereinbelow given of a method for manufacturing an electronic component-mounted component and an electronic component-mounted component in the embodiments of the present invention with reference to the drawings. Herein, the electronic component-mounted component is a component manufactured by the method for manufacturing an electronic component-mounted component. It is noted that like component members are designated by like reference numerals throughout the drawings.

[0125] As an example that achieves the function of the electronic component-mounted component, MCM (Multi Chip Module) and a sheet module (including memory cards and non-contact IC cards) are adopted in the present embodiment. However, the present invention is not limited thereto.

[0126] (First Embodiment)

[0127] **FIG. 1** is a view showing an electronic component-mounted component **700** manufactured by using a method for manufacturing an electronic component-mounted component of the present embodiment. The electronic component-mounted component **700** is composed of: a first electronic component-mounted component **150** corresponding to one example of an electronic component-mounted component with a first electronic component (the first electronic component is also one example of an electronic component) inserted or embedded for example, therein; and a second electronic component (the second electronic component is also an example of an electronic component) mounted on the first electronic component-mounted component **150**. In the present embodiment, examples of the component corresponding to the first electronic component include a semiconductor device **101-1** that is a bare IC chip or a capacitor component **105-1**. The first electronic component-mounted component **150** has the semiconductor device **101-1** and the capacitor component **105-1** embedded in a first resin base substrate **140** corresponding to one example of a base substrate that is made of a sheet-like resin material. On a circuit formation face **141** of the first resin base substrate **140**, there are exposed: a bump **113** formed in each of a plurality of electrodes **102** on the semiconductor device **101-1**; and each of electrodes **106** of the capacitor component **105-1**. On the circuit formation face **141**, there are formed first circuit patterns **115** that are electrically connected to each of the bumps **113** that are an example of a protruding electrode and to each of the electrodes **106**, and therefore the semiconductor device **101-1** and the capacitor component **105-1** are electrically connected to the first circuit patterns **115**. Also in the present embodiment, examples of the component corresponding to the second electronic component include a semiconductor device **101-2** that is a bare IC chip or a capacitor **105-2**. These semiconductor device **101-2** and the capacitor **105-2** are mounted on the first circuit pattern **115**. Therefore, the first electronic component and the second electronic component are electrically connected via the first circuit pattern **115**.

[0128] It is noted that examples of the electronic components such as the capacitor components **105-1, 105-2**, are not limited to capacitors, and other components such as resistors may be included in the examples. Further, sheet-like components may be substituted for chip-like components. It is noted that the semiconductor devices **101-1, 101-2** may be generically referred to as a semiconductor devices **101**, and

the capacitor components **105-1**, **105-2** may be generically referred to as capacitor components **105**.

[0129] Following description discusses the method for manufacturing the electronic component-mounted component **700** having the above configuration with reference to FIGS. **2** to **8**.

[0130] **FIG. 2** is a view showing the semiconductor device **101**, in which reference numeral **102** denotes electrodes of the semiconductor device **101**, and reference numeral **112** denotes a passivation film for protecting the active face of the semiconductor device **101**. **FIG. 3** is a view showing a capacitor component **105** having external electrodes **106**.

[0131] In the step **101** (a word "step" is referred to as "S" in **FIG. 8**) shown in **FIG. 8**, each bump **113** is formed on each of the electrodes **102** of the semiconductor device **101** by wire bonding method with use of metal wires made of gold, copper and solder. It is noted that a formation method of the bump **113** is not limited to the wire boding method, and so a plating method is also applicable.

[0132] In the next step **102**, the semiconductor device **101-1** and the capacitor component **105-1** with each of the bumps **113** formed thereon are mounted on a sheet-like thermoplastic first resin base-substrate **140** formed from a resin having electrical insulation such as polyethylene phthalate, polyvinyl chloride, polycarbonate, acrylonitrile butadiene, polyimide, and epoxy. In some cases, a plurality of the semiconductor devices **101-1** and the capacitor components **105-1** are mounted, or the capacitor component **105-1** is not mounted at all.

[0133] Here, since the bumps **113** and the external electrodes **106** need to be exposed from the circuit formation face **141** of the first resin base-substrate **140** as described later in this embodiment, it is preferable that a thickness of the first resin base substrate **140** is basically equal to or larger than a thickness of the semiconductor device **101-1** and equal to or smaller than the sum of a thickness of the semiconductor device **101-1** and a height of the bump **113**. For example, if the thickness of the semiconductor device **101-1** is 0.18 mm and the height of the bump **113** is 0.04 mm, the thickness of the first resin base substrate **140** is preferably 0.2 mm. It is also preferable to use the capacitor component **105-1** whose thickness is larger by approx. 50 μm than the thickness of the first resin base substrate **140**. The thickness of the capacitor component **105-1** is no less than the thickness of the first resin base substrate **140**.

[0134] In the next step **103**, the first resin base substrate **140** with the semiconductor device **101-1** having the bumps **113** and the capacitor component **105-1** mounted thereon as shown in **FIG. 4** is interposed between hot pressing plates **171**, **172** as shown in **FIG. 5**, where the semiconductor device **101-1** having the bumps **113**, the capacitor component **105-1** and the first resin base substrate **140** are heated by a heating apparatus **173** while being pressed relatively by a pressing apparatus **174**, by which the semiconductor device **101-1** and the electronic component **105-1** are pressed and embedded in the first resin base substrate **140**. The hot pressing conditions in the case of using a first resin base substrate **140** made of, for example, polythene terephthalate, are such that pressure is 30×10^5 Pa, temperature is 160° C., and pressing time is 1 minute. It is noted that the temperature and pressure differ by materials of the first resin base substrate **140**. The pressing conditions are controlled by a controller **180** that controls the heating apparatus **173** and the pressing apparatus **174**. The pressing operation of the semiconductor device **101-1** and the capacitor component **105-1** may be individually performed by using separate hot pressing plates.

[0135] **FIG. 6** corresponding to the next step **104** is a cross sectional view showing the state of the semiconductor device **101-1**, the capacitor component **105-1** and the first resin base substrate **140** after execution of the pressing step. As shown in **FIG. 6**, in the present embodiment, by the operation of inserting the semiconductor device **101-1** and the capacitor component **105-1** in the first resin base substrate **140**, end faces **113*a*** of the bumps **113** and end faces **106*a*** of the electrodes **106** of the electronic component **105**, that are the faces of each of the bumps **113** and the electrodes **106** that are brought into contact with the hot pressing plate **171** by the pressing operation, are exposed from the circuit formation face **141** of the first resin base substrate **140**, and in this state the semiconductor device **101-1** and the capacitor component **105-1** are embedded in the first resin base substrate **140**.

[0136] Here in the present embodiment, for decreasing the thickness of the component, a back face **101*a*** opposed to the active face of the semiconductor device **101-1** and an end face **105*a*** of the capacitor component **105-1** are the same face as an opposite face **142** of the first resin base substrate **140** opposed to the circuit formation face **141** as shown in the drawing. However, the present invention is not limited thereto. More specifically, depending on each semiconductor component-mounted component, by adjusting the above-described thickness of the first resin base substrate **140**, the pressing force of the hot pressing plates **171**, **172**, and the like, the back face **101*a*** of the semiconductor device **101-1** and the end face **105*a*** of the capacitor component **105-1** may be protruded from, for example, the opposite face **142** of the first resin base substrate **140**.

[0137] It is noted that a word "embedding" used in the present first embodiment throughout the later-described eighth embodiment refers to the state that electronic components such as the semiconductor device **101-1** and the capacitor component **105-1** are inserted in a base substrate so that each electrode of the electronic components is exposed from the surface of the base substrate. On contrary to this, a word "embedding" used in the later described ninth embodiments and the following embodiments refers to the state that the electronic components are embedded in the base substrate with each electrode not exposed from the surface of the base substrate.

[0138] In the next step **105** as shown in **FIG. 7, a** first circuit pattern **115** that is electrically connected to the semiconductor device **101-1** and the capacitor component **105-1** is formed on the circuit formation face **141** of the first resin base substrate **140** so as to come into contact with the end faces **113*a*** of the bumps **113** and the end faces **106*a*** of the capacitor component **105-1** with use of conductive paste such as silver and copper. Formation of the first circuit pattern **115** with the conductive paste is generally performed by screen printing, offset printing, gravure, or the like. In the case of the screen printing, for example, a conductive paste is printed via a **165** meshes/inch mask with an emulsion thickness of 10 μm for forming a first circuit pattern **115** with a conductor thickness of approx. 30 μm.

[0139] Formation of the first circuit patterns **115** are not limited to formation by printing of conductive paste, and therefore the first circuit pattern **115** may be formed by thin-film formation and the like by such method as metal plating and deposition with use of copper, Ni, aluminum or the like.

[0140] Thus, there is established electric connection of the first circuit patterns **115** to the semiconductor device **101-1** and the capacitor component **105-1**. A component portion in the state shown in **FIG. 7** is the first electronic component-mounted component **150**.

[0141] In the next step **106**, a semiconductor device **101-2** and a capacitor component **105-2**, that are second electronic components, are mounted on the first circuit patterns **115** of the first electronic component-mounted component **150** to complete MCM corresponding to one example that achieves the function of the electronic component-mounted component **700** as shown in **FIG. 1**. It is noted that a method for mounting the semiconductor device **101-2** and the capacitor component **105-2** on the first circuit patterns **115** of the first electronic component-mounted component **150**, though unshown, is performed by general circuit mounting method such as soldering, bonding with silver paste and the like. In **FIG. 1**, reference numeral **170** denotes an insulation encapsulant for protecting the semiconductor device **101-2**.

[0142] Thus, according to the present invention, the module has the structure in which the semiconductor device **101** and the capacitor component **105** are embedded in the first resin base substrate **140**, which is different from the structure of stacking components on the carrier substrate **3** as described in the conventional example. Therefore, the thickness of the module may be decreased by the thickness of the carrier substrate **3**, which makes it possible to satisfy recent product needs of reduced thickness.

[0143] Also, by forming the first circuit patterns **115** so that the first circuit patterns **115** comes into direct contact with each of the bumps **113** of the semiconductor device **101-1** and each of the electrodes **106** of the capacitor component **105-1**, the necessity of forming electrodes for wire bonding in the peripheral portion of the semiconductor device may be eliminated. This makes it possible to use semiconductor devices of arbitrary sizes in stacking up the semiconductor devices. Further, since there is no limitation of the position of the electrode of the semiconductor device, it becomes possible to stack area pad-type semiconductor devices.

[0144] (Second Embodiment)

[0145] In the second embodiment, after forming the first electronic component-mounted component **150** in the step **105** of **FIG. 8** and before mounting the second electronic component on the first circuit pattern **115** in the step **106**, a second resin base-substrate **161** (the second resin base-substrate **161** is an example of a insulation protecting sheet) having electric insulating such as polyethylene phthalate, polyvinyl chloride, polycarbonate, acrylonitrile butadiene, polyimide and epoxy is disposed on an opposite face **142** opposed to the circuit formation face **141** of the first electronic component-mounted component **150**, and is heat-fused by lamination processing, by which the first electronic component-mounted component **150** is sealed. The lamination processing is performed by pressing and heating the second resin base-substrate **161** with hot pressing plates **171**, **172** having a plane face as shown in **FIG. 9**. The processing conditions in the case of using a second resin base-substrate **161** made of, for example, polythene terephthalate, are such that pressure is 30×10^5 Pa, temperature is 160° C., pressing up time is 1 minute, and pressure holding time is 1 minute.

[0146] Also, the lamination processing may be performed by roll-press method shown in **FIG. 10**. In **FIG. 10**, reference numerals **310**, **311** denote rollers that are heated by a heating apparatus **312** and rotated by a driving amount **313**. The second resin base-substrate **161** is fed to between the rollers **310**, **311** so that the first electronic component-mounted component **150** is pressed in the thickness direction, and the second resin base-substrate **161** is laminated and heat-fused in the thickness direction. The processing conditions in the case of using a second resin base-substrate **161** made of, for example, polythene terephthalate, are such that pressure is 30×10^5 Pa, temperature is 140° C., and a lamination rate is 0.1 m/min.

[0147] Through the above-described process, there is manufactured an electronic component-mounted component **151** shown in **FIG. 12** that is a modified example of the above-described first electronic component-mounted component **150**.

[0148] In executing the lamination step in the case where the first resin base substrate **140** and the second resin base-substrate **161** that are not heat-fused are used as a material combination, there may be interposed a binder **162** such as epoxy and acryl between the first electronic component-mounted component **150** and the second resin base-substrate **161** as shown in **FIG. 11**.

[0149] In this case, there is manufactured an electronic component-mounted component **152** shown in **FIG. 13** that is a modified example of the above-described first electronic component-mounted component **150**.

[0150] Then, as with the case of the first embodiment, these electronic component-mounted components **150**, **151**, **152** undergo mounting of the semiconductor device **101-2** and the capacitor component **105-2** as second electronic components on the first circuit pattern **115**. Consequently, there is completed MCM corresponding to one example that achieves the function of an electronic component-mounted component **701** as a module with the semiconductor device **101-2** and the capacitor component **105-2** mounted thereon as shown in **FIG. 14**.

[0151] According to the second embodiment, the semiconductor device **101-1** and the capacitor component **105-1** embedded in the first resin base substrate **140** are sealed by the second resin base-substrate **161**, which makes a module superior in terms of moisture resistance to the module of the first embodiment.

[0152] (Third Embodiment)

[0153] In the third embodiment, after forming the first electronic component-mounted component **150** in the step **105** shown in **FIG. 8** and before proceeding to the step **106**, a first substrate **260** with a circuit pattern formed thereon is mounted on the first circuit pattern **115** of the first electronic component-mounted component **150** as shown in **FIG. 15**. The first substrate **260** is a general circuit board made of a insulation material that has been conventionally used as a

circuit board such as glass epoxy, phenol and ceramic. Also, third circuit patterns **261** and fourth circuit patterns **262** are formed on the both faces of the first substrate **260** that are opposite to each other in the thickness direction of the first substrate **260**, and further there is formed, along a thickness direction **264**, a first substrate through hole **263** that is a through hole for electrically connecting the third circuit patterns **261** and the fourth circuit patterns **262**. Therefore, the first substrate **260** is a substrate, the both sides of which are mountable. The first electronic component-mounted component **150** and the first substrate **260** are joined by electrically connecting the first circuit patterns **115** of the first electronic component-mounted component **150** and the fourth circuit patterns **262** of the first substrate **260** and superposing them on top of each other in the thickness direction thereof. Next, there is interposed, for example, a conductive binder between the first electronic component-mounted component **150** and the first substrate **260**, and lamination processing of the first electronic component-mounted component **150** is performed on the first substrate **260** so that the first electronic component-mounted component **150** is integrated with the first substrate **260**. Thus, an electronic component-mounted component **153** shown in **FIG. 16** is completed. It is noted that the first substrate through hole **263** refers to a "through hole" formed by forming a hole that connects the both side of the first substrate **260**, and filling inside of the hole with a conductor or coating the inner circumferential face of the hole with a conductor, where the conductor and the hole is in an integrated state. Other "through holes" described later are also the same.

[0154] After manufacturing the electronic component-mounted component **153**, the semiconductor device **101-2** and the capacitor component **105-2** that are the second electronic components are mounted on the third circuit patterns **261** of the first substrate **260**. Thus, there is completed MCM corresponding to one example that achieves the function of an electronic component-mounted component **702** with the semiconductor device **101-2** and the capacitor component **105-2** mounted thereon as shown in **FIG. 17**.

[0155] It is noted that in the third embodiment, mounting of the second electronic component is executed after manufacturing of the electronic component-mounted component **153**. However, as shown in **FIG. 18, a** first substrate **265** with the second electronic components mounted in advance on the third circuit patterns **261** may be joined to the first electronic component-mounted component **150**.

[0156] Thus, in the third embodiment like the first embodiment and the second embodiment described before, recent product needs of reduced thickness may be satisfied, the necessity of forming an electrode for wire boding in the peripheral portion of a semiconductor device may be eliminated, semiconductor devices of arbitrary sizes may be used, and therefore area pad-type semiconductor devices may be used.

[0157] Further in the third embodiment, using a general circuit board as the first substrate **260** enables application of a reflow technique, that is a conventional printing technique for surface mounting, and therefore a degree of difficulty in module formation may be lowered.

[0158] (Fourth Embodiment)

[0159] In the fourth embodiment, in lamination-bonding the first substrate **260** or the first substrate **265** shown in **FIG. 18** to the first electronic component-mounted component **150** after formation of the first electronic component-mounted component **150**, it is structured that a binder **162** such as epoxy, acryl, anisotropic conductive sheets, and anisotropic conductive pastes is interposed between the first electronic component-mounted component **150** and the first substrate **260** or the first substrate **265** like an electronic component-mounted component **703** shown in **FIG. 19**. Herein, as shown in **FIG. 20**, increasing the thickness of the binder **162** makes it possible to laminate the first substrate **260** or the first substrate **265** on the side of second electronic components **101-2, 105-2** provided on the electronic component-mounted component **700** shown in **FIG. 1**. It is noted that in **FIG. 20**, reference numeral **163** denotes an electrode for electrically connecting the fourth circuit pattern **262** of the first substrate **260** or the first substrate **265** to the first circuit pattern **115** of the first electronic component-mounted component **150**.

[0160] Also in the above-described case, when the first substrate **260** is joined to the first electronic component-mounted component **150**, it becomes possible to mount a semiconductor device **101-3** and a capacitor component **105-3**, that are third electronic components, on the third circuit patterns **261** of the first substrate **260** like an electronic component-mounted component **704** shown in **FIG. 21**. It is noted that the first substrate **265** with electronic components mounted in advance may be used. Therefore, order of the mounting process of the third electronic components **101-3, 105-3** is passed over.

[0161] (Fifth Embodiment)

[0162] In the fifth embodiment, like an electronic component-mounted component **705** shown in **FIG. 22**, on an opposite face **142** opposed to a circuit formation face **141** of the first electronic component-mounted component **150** provided on each of the electronic component-mounted components **702, 703, 704** manufactured in the third and the fourth embodiments, a second resin base-substrate **161** having electric insulating such as polyethylene phthalate, polyvinyl chloride, polycarbonate, acrylonitrile butadiene, polyimide and epoxy is disposed, and the first electronic component-mounted component **150** is lamination-processed. Thus, an electronic component-mounted component **705** with the second resin base-substrate **161** being heat-fused to the first electronic component-mounted component **150** may be manufactured.

[0163] Thus, by executing lamination-processing in the second resin base-substrate **161**, the semiconductor device **101-1** and the capacitor component **105-1** embedded in the first resin base substrate **140** are sealed by the second resin base-substrate **161** as with the case of the second embodiment, which enables provision of a module excellent in moisture resistance.

[0164] (Sixth Embodiment)

[0165] The sixth embodiment as shown in **FIG. 23** is different from the above-described first to fifth embodiments in the point that an electronic component-mounted component **154** with circuit patterns formed on the both sides of the first resin base substrate **140** is used. The electronic component-mounted component **154** is formed by the same formation method of the above-stated first electronic component-mounted component **150**, though the electronic com-

ponent-mounted component **154** has a through hole **117** that is an example of a through hole that passes through the first resin base-substrate **140** along the thickness direction of the first resin base substrate **140**. The through hole **117** is formed by pressing with a mold or with an NC puncher. The through hole **117** is filled with a conductive material when the first circuit patterns **115** is formed, and is electrically connected to later-formed second circuit patterns **116**.

[**0166**] Various processing as mentioned earlier may be applied to the thus-formed electronic component-mounted component **154**. For example, like an electronic component-mounted component **706** shown in **FIG. 24**, the semiconductor device **101-2** and the capacitor component **105-2**, that are the second electronic components, are mounted on the first circuit patterns **115**, and further the semiconductor device **101-3** and the capacitor component **105-3** corresponding to the third electronic components may be mounted on the second circuit patterns **116**. It is noted that order of mounting the second electronic component and the third electronic component is not specifically defined.

[**0167**] Also, in the electronic component-mounted component **154** shown in **FIG. 23**, the second circuit patterns **116** are formed on the opposite face **142**. However, it is also possible to form an electronic component-mounted component **155** with the through hole **117** electrically connected to the first circuit pattern **115** without forming the second circuit patterns **116**. With use of the electronic component-mounted component **155**, an electronic component-mounted component **707** shown in **FIG. 25** may be structured. In the electronic component-mounted component **707**, on the opposite face **142** of the first resin base-substrate **140** constituting the electronic component-mounted component **155**, a second substrate **270** having the same structure as the aforementioned first substrate **260** is disposed so that a sixth circuit pattern **272** of the second substrate **270** is electrically connected to the through hole **117**. Herein, the second electronic components **101-2**, **105-2** may be mounted on the electronic component-mounted component **155**, or they may be mounted later. Also, the semiconductor device **101-3** and the capacitor component **105-3** as the third electronic components may be mounted on a fifth circuit patterns **271** of the second substrate **270**, or they may be mounted later.

[**0168**] Also, an electronic component-mounted component **708** as shown in **FIG. 26** may be structured with use of the electronic component-mounted component **155**. In the electronic component-mounted component **708**, the electronic component-mounted component **155** is lamination-processed from the both sides of the thickness direction thereof on the first substrate **260** and the second substrate **270**. On the first substrate **260** and the second substrate **270** to be installed in the electronic component-mounted component **155**, the second electronic components **101-2**, **105-2**, and the third electronic components **101-3**, **105-3** may be mounted in advance or may be mounted after the installation.

[**0169**] Furthermore, an electronic component-mounted component **709** as shown in **FIG. 27** may be structured with use of the electronic component-mounted component **155**. The electronic component-mounted component **709** has a structure of the electronic component-mounted component **708**, in which the electronic component-mounted component **155** and the first substrate **260** are joined by a binder **162** like the electronic component-mounted component **703** described with reference to **FIG. 19**.

[**0170**] Thus, there may be deployed various forms consisting of combinations of the electronic component-mounted component **154** shown in **FIG. 23** and the electronic component-mounted component **155** shown in **FIG. 25** and various forms described with reference to **FIG. 9** through **FIG. 22**. Eventually, **FIG. 24** to **FIG. 27** show only part of possible combinations.

[**0171**] (Seventh Embodiment)

[**0172**] An electronic component-mounted component **300** shown in **FIG. 28** in the seventh embodiment has a structure in which a plurality of the electronic component-mounted components **155** described with reference to **FIG. 25** are superposed in the thickness direction and lamination-processed. The lamination-processing conditions in the case of using a first resin base-substrate **140** made of, for example, polythene terephthalate, are such that pressure is 30×10^5 Pa, temperature is 160° C., pressing up time is 1 minute, and pressure holding time is 1 minute.

[**0173**] Various combinations may be implemented for the electronic component-mounted component **300** formed as described above as with the aforementioned sixth embodiment, including mounting of the semiconductor device **101** and the capacitor component **105**, and joining of the first substrate **260** or the first substrate **265** shown in **FIG. 18** having the semiconductor device **101** and the capacitor component **105** mounted in advance thereon. **FIG. 29** is a view showing an electronic component-mounted component **710** as one example of an electronic component-mounted component manufactured by such combinations.

[**0174**] (Eighth Embodiment)

[**0175**] In the foregoing first to seventh embodiments, there is a step of embedding the semiconductor device **101-1** and the capacitor component **105-1** in the first resin base-substrate **140**. However, there may be used a base substrate in which the electronic components including the semiconductor device **101** and the capacitor component **105** are molded in advance in the resin base substrate by injection molding and the like. Then on the base substrate, a circuit pattern may be formed to form an electronic component-mounted component **150** or the like.

[**0176**] Also as shown in **FIG. 30**, in the electronic component-mounted component **150** after the semiconductor device **101-1** and the capacitor component **105-1** are embedded in the first resin base-substrate **140**, or the electronic component-mounted component **150** with the electronic components already embedded in the first resin base-substrate **140** and the like, if the bumps **113** of the semiconductor device **101-1** and the electrodes **106** of the capacitor component **105-1** are not exposed from the circuit formation face **141**, the circuit formation face **141** may be subjected to polishing and plasma-etching or the like to expose the bumps **113** and the electrodes **106** from the circuit formation face **141**, and then formation of circuit patterns may be performed.

[**0177**] (Ninth Embodiment)

[**0178**] Next, detailed description will be given of a method for manufacturing an electronic component-mounted component in the case of exposing each of the

bumps and electrodes by the above polishing, plasma-etching or the like in the ninth embodiment and the following embodiments thereof with reference to drawings.

[0179] Before describing each of the ninth embodiment and the following embodiments, first, another conventional manufacturing method different from the foregoing conventional manufacturing method of the electronic component-mounted component will be described with reference to **FIG. 36** and **FIG. 37**.

[0180] Conventionally, in CSP, MCM, memory modules with electronic components such as semiconductor devices and passive components being mounted thereon, there is adopted a method for heating and pressure-welding a semiconductor device on a carrier substrate via conductive adhesive or a sheet. Also, the electronic component is mounted by a method for printing a solder paste on specified circuit patterns on a carrier substrate and then reflowing the solder paste.

[0181] More specifically, as shown in **FIG. 36**, the electronic component-mounted component is formed such that protruding electrodes **602** formed on unshown electrode pads of a semiconductor device **601** is electrically joined to electrodes **603** on a carrier substrate **606** via an unshown anisotropic conductive adhesive. It is noted that an encapsulant **605** is injected and hardened in between the semiconductor device **601** and the carrier substrate **606** for increasing the joining strength thereof.

[0182] Also, the carrier substrate **606** and an electronic component **609** are joined to each other through joining of specified electrodes **604** on the carrier substrate **606** and electrodes **610** of the electronic component **609**, and specified electrodes **608** of a mother board **611** via solder paste **607**. It is noted that reference numeral **613** in **FIG. 36** denotes a through hole having a conductor formed therein for electrically joining the electrode **608** on the surface of the mother board **611** and a circuit pattern **612** on the back face of the mother board **611**. In a module that fulfills the function of a product only with one face on which the electrodes **608** are formed, the through hole **613** is not necessary. The manufacturing process thereof is structured such, as shown in **FIG. 37**, that first in the step (referred to as "S" in the drawing) **11**, solder paste is printed and applied on specified electrodes **607** on the mother board **611**. The solder paste **607** is printed generally by screen printing method.

[0183] Next in the step **12**, the carrier substrate **606** with the semiconductor device **601** mounted thereon and the electronic component **609** are aligned and mounted on the solder paste **607** formed on the mother board **611** by the above printing.

[0184] Next in the step **13**, the carrier substrate **606** with the semiconductor device **601** mounted thereon and the mother board **611** with the electronic component **609** mounted thereon are put in a reflow furnace so that the solder paste **607** is melted and then hardened.

[0185] Thus, a memory module **614** as an electronic component-mounted component is manufactured.

[0186] However, the above-described conventional method for manufacturing the electronic component-mounted component, as well as MCM, memory modules and the like as the electronic component-mounted components manufactured by the above manufacturing method of an electronic component-mounted component have following problems in terms of their structure.

[0187] For mounting electronic components such as CSP on the mother board **611**, the height of a module in a thickness direction is increased, which makes it impossible to satisfy recent product needs of reduced the thickness.

[0188] Consequently, the module is susceptible to an influence of bending, and it is hard to soften the module, which makes it difficult to apply the module to such configuration as curved surfaces. Also, there is required an area for mounting the electronic component **609** and the carrier substrate **606** on the mother board **611**. Eventually, the number of electronic components mountable on one mother board **611** and the area for forming circuit patterns are determined by the size of the mother board **611**, which makes it impossible to satisfy recent product needs of downsizing of the mother board **611**.

[0189] Further, since the semiconductor device **601** and the solder paste **607** are directly exposed to the air, use thereof in an environment of high temperature and high humidity causes oxidation, which tends to cause electric short-circuit, open fault, and reduction of joining strength. Further, presence of dispersion of temperature in the reflow furnace disables increase of the substrate size. This makes batch-processing a main stream, resulting in poor productivity.

[0190] In views of the background of this conventional method for manufacturing an electronic component-mounted component, description will be given of the ninth embodiment of the present invention hereinbelow.

[0191] **FIGS. 31A, 31B, 31**C and **31**D are fragmentary cross sectional views each showing the manufacturing process of a method for manufacturing an electronic component-mounted component according to the ninth embodiment of the present invention. This manufacturing process consists of a step of inserting, e.g., embedding, an electronic component as the first electronic component in a base substrate, and a step of exposing electrodes of the embedded electronic component from the surface of the sheet base substrate.

[0192] Here, as one example, there is described a method for forming a sheet module exemplifying an electronic component-mounted component in which an electronic component **501** including capacitor components, passive components such as resist components, semiconductor devices and CSP components is embedded in a thermoplastic resin sheet base-substrate **503** exemplifying a base substrate. It is noted that the electronic component-mounted component is not limited to such a sheet module, but may include, for example, MCM (Multi Chip Module).

[0193] Preferably, the thermoplastic resin sheet base-substrate **503** has electrical insulation like polyethylene phthalate, polyvinyl chloride, polycarbonate, acrylonitrile butadiene and thermoplastic polyimide, and the thickness thereof is 10 μm to 1 mm.

[0194] **FIGS. 31A, 31B, 31**C and **31**D are fragmentary cross sectional views each showing one example of the step of embedding the electronic component **501** in the thermoplastic resin sheet base-substrate **503**. It is noted that embed-

ding of the electronic component **501** in the thermoplastic resin sheet base-substrate **503** may be achieved by methods other than the method stated above.

[0195] **FIG. 31A** is a fragmentary cross sectional view showing a state prior to embedding the electronic component **501** in the thermoplastic resin sheet base-substrate **503**, where the thermoplastic resin sheet base-substrate **503** is placed on a heating stage **505**, and the electronic component **501** having a plurality of electrodes **502** is placed on top of the thermoplastic resin sheet base-substrate **503**. A press tool **504** is disposed on top of the electronic component **501**. It is noted that the surface of the heating stage **505** and the press tool **504** are preferably planar and made of glass, stainless, ceramic and polytetrafluoroethylene like, for example, Teflon (registered trademark). Though not shown in the drawing, a base substrate such as ceramic plates and Teflon (registered trademark) sheets may be interposed between a capacitor component **501** as an example of the electronic component **501** and the press tool **504**, or between the sheet base-substrate **503** and the heating stage **505**. The base substrate is interposed as described the above because the thermoplastic resin sheet base-substrate **503** is gelled and obtains viscosity when it is heated over its glass transition point, so that the sheet-substrate **503** adheres to a heating tool **4** and the stage **5** and sticks thereon. If cooled in this state, the sheet-substrate **503** is hardened and contracted, which makes it further stick thereon. Therefore, it is desirable to use a base substrate such as Teflon (registered trademark) as a release member. For example, when a semiconductor device having a thickness of 180 μm exemplifying the electronic component **501** is embedded in a polyester terephthalate substrate exemplifying the base substrate, it is desirable to dispose Teflon (registered trademark) having a thickness of 50 μm to 100 μm therebetween. The base substrate is disposed therebetween because the polyester terephthalate has a glass transition point of 120° C., at which the heating tool is heated up to 200° C. In view of heat resistance, polytetrafluoroethylene is preferable. It is noted that if the thickness thereof is too large, the semiconductor device is embedded not in the thermoplastic base substrate but in a release paper, whereas if the thickness is too small, there is the possibility that the release paper is broken when it is brought into contact with the back face of the semiconductor device. When a semiconductor device of 0.180 mm in thickness having protruding electrodes of 0.040 mm in height is embedded in a PET sheet base-substrate of 0.200 mm in thickness, an appropriate thickness of Teflon (registered trademark) is 0.050 to 0.100 mm.

[0196] In the embedding step, the electronic component **501** is pressed into the thermoplastic resin sheet base-substrate **503** while the heated press tool **504** is pressed an arbitrary load toward the heating stage **505**, so that the electronic component **501** is embedded in the thermoplastic resin sheet base-substrate **503**. In this state, a back face **501***r* of the electronic component **501** in contact with the press tool **504** forms a plane approximately identical to a back face **503***r* of the sheet-substrate **503**.

[0197] **FIG. 31B** is a view showing a state of the electronic component **501** embedded in the thermoplastic resin sheet base-substrate **503**. It is noted that when the thermoplastic resin sheet base-substrate **503** is heated while the electronic component **501** is being embedded therein, the thermoplastic resin sheet base-substrate **503** is preferably heated such that the heating temperate is between a glass transition point of the thermoplastic resin sheet base-substrate **503** and an upper-limit temperature at which the viscosity of the thermoplastic resin sheet base-substrate **503** decreases and the electronic component **501** passes through the thermoplastic resin sheet base-substrate **503**. For example, in the case where an electronic component consisting of a chip capacitor of 0.3 mm×0.6 mm×0.3 mm is embedded in a sheet substrate made of polyethylene terephthalate, it is desirable that the sheet substrate made of polyethylene terephthalate has: a thickness of 0.3 to 0.4 mm; resin temperature in embedding operation of 150 to 170° C.; a load of 40 to 50 kgf (392.4 to 490.5N) or pressure of approx. 2.9×10^{6} Pa; and pressing time of 20 s to 150 s.

[0198] Next, the press tool **504** is lifted up, and the sheet-substrate **503** with the electronic component **501** embedded therein is detached from the heating stage **505** and cooled down to a room temperature, by which the sheet-substrate **503** is hardened and the electronic component **501** is embedded in the sheet-substrate **503**.

[0199] However in this point, each of the electrodes **502** of the electronic component **501** embedded in the sheet-substrate **503** does not break through the sheet-substrate **503** nor protrude from the surface of the sheet, and therefore only the back face **501***r* of the electronic component **501** in contact with the press tool **504** forms a plane approximately identical to the back face **503***r* of the sheet-substrate **503**, which signifies that only one side of the sheet surfaces (that is the back face **501***r* of the electronic component **501** in this case) is exposed from the surface on the side of the back face **503***r* of the sheet-substrate **503**, so that joining with each of the electrodes **502** on the side of the top face **501***f* of the electronic component **501** is not attained. For example in the above-stated example, a maximum distance from the electrode to the surface of the sheet-substrate **503** is 0.4 mm–0.3 mm 0.1 mm=100 μM. Also, in the case of an electronic component having electrodes only on one side such as IC chips (that is, on the front face of an IC chip), electric joining is not attainable from the back face of the IC chip, which means that electric joining is not obtainable from any face of the sheet-substrate **503**.

[0200] Accordingly in the exposing step, each of the electrodes **502** is exposed from the surface of the sheet-substrate **503** by using polishing processing that exemplify electrode exposing method or by plasma discharge processing, or by using the both of them.

[0201] **FIG. 31C** is a fragmentary cross sectional view showing polishing processing. The sheet-substrate **503** with the electronic component **501** embedded therein is fixed to a polishing processing stage **510** by using a fixing jig or by sucking. A polishing paper **507** is placed and pressed by a polisher **506** on the face of the sheet-substrate **503** from which the electrodes **502** are desired to be exposed, and then the polishing paper **507** is rotated or moved in a horizontal direction for polishing the sheet-substrate **503**. It is desirable that the sheet-substrate **503** is polished with use of polishing papers finer in the order of #80, #100, #150, #500, #800, #1000, #1200, #1500, #2000, and then the sheet-substrate **503** is buffed with ceramic powders (e.g. alumina) with smaller grain sizes in the order of 1 μm, 0.5 μm, 0.3 μm or the like. It is noted that it is not necessary to use all the polishing papers and powders with roughness and grain size

defined in here, and therefore those with other roughness and grain sizes may be also applicable. Further, it is desirable to use water and organic solvent for removing polishing powders in polishing. Performing such polishing step enables a plurality of the electrodes **502** to be exposed from the surface of the sheet-substrate **503**.

[**0202**] Also, **FIG. 31D** is a fragmentary cross sectional view showing the step of plasma discharge processing. The sheet-substrate **503** with the electronic component **501** mounted thereon is put in a vacuum chamber **509** of a vacuum furnace, and fixed to a plasma-discharge lower-side electrode **512** in the vacuum chamber **509**. The vacuum chamber **509** is vacuumed to make a reduce-pressure state, and inert gas such as Ar is introduced in the vacuum chamber **509**, where high voltage is applied to between a plasma-discharge upper-side electrode **511** and the plasma-discharge lower-side electrode **512** for generating plasma between the upper-side electrode **511** and the lower-side electrode **512** in the vacuum chamber **509** to perform plasma etching. It is noted that locally concentrated generation of plasma may be achieved by simultaneous use of magnetic electric fields and the like. Plasma beats particles out of the sheet-substrate **503**, by which the sheet-substrate **503** is ground down in its thickness direction.

[**0203**] Specific examples of the electrode exposing method in the exposing step include the following methods: (1) the sheet-substrate **503** is polishing-processed till the electrodes **502** are exposed; (2) the sheet-substrate **503** is plasma-processed till the electrodes **502** are exposed; (3) the sheet-substrate **503** is roughly ground down by polishing processing and finished by plasma discharge processing for exposing the electrodes **502**; and (4) combination method in which the entire sheet-substrate **503** is ground down by polishing processing and only the vicinity of the electrode **502** is plasma discharge-processed.

[**0204**] Employment of these methods bring about advantages that (1) it becomes possible to collectively expose a plurality of electrodes **502**, resulting in improved productivity, and (2) the surface of a sheet after the polishing is a planar, which facilitates printing, film formation, lamination of sheet modules, formation of a card on the surface of the sheet, and makes the component practicable.

[**0205**] Particularly, like the aforementioned first embodiment to the eighth embodiment, in a state of the electronic component being embedded in the base substrate, it becomes possible to eliminate the necessity of selecting the base substrate and the electronic components so that each of the electrodes of the electronic component has a thickness that ensures exposure from the surface of the base substrate. More specifically, when each of the electrodes **502** of the electronic component **501** is embedded in the sheet-substrate **503** in the embedding state as described the above, the polishing processing or the plasma processing are performed so that each of the electrodes **502** are possible to be exposed from the surface of the sheet-substrate **503**.

[**0206**] According to the ninth embodiment, therefore, the electronic component **501** is embedded in the sheet-substrate **503**, which makes it possible to decrease the thickness of the sheet module, thereby enabling decrease of the thickness. Further, since the thin sheet module is softer than a conventional substrate, it possible to be used on a curved face or a place where bending operation is performed. Furthermore, in the case where an IC chip as one example of an electronic component **1** is built in the sheet-substrate **503**, a film formation area and a circuit pattern formation area on a substrate or the sheet-substrate **503** may be enlarged, which enables implementation of high functions and downsizing of the substrate.

[**0207**] (Tenth Embodiment)

[**0208**] In the ninth embodiment, the electronic component is exemplified by a chip-type capacitor component and passive component such as resists. However the electronic component may be a semiconductor device that is a bare IC chip. In a tenth embodiment of the present invention, a semiconductor device is taken as an example of the electronic component, and the manufacturing process of a semiconductor device-mounted component as one example of an electronic component-mounted component will be described with reference to **FIG. 32**A, **FIG. 32**B, **FIG. 32**C, **FIG. 32**D, **FIG. 32**E and **FIG. 32**F.

[**0209**] In the manufacturing method of the semiconductor device-mounted component is mainly structured by the step of: first, forming a protruding electrode on each of electrode pads of a semiconductor device exemplifying the first electronic component; next, leveling a height of each of the protruding electrodes; inserting the semiconductor device, or embedding for example, in a sheet base substrate; and then exposing a surface of each of the protruding electrodes (the protruding electrode is one example of an electrode) from the surface of the sheet base substrate. It is noted that the step of leveling the height of protruding electrodes may be omitted. Hereinbelow, detailed description will be given of each step with reference to **FIG. 32**A, **FIG. 32**B, **FIG. 32**C, **FIG. 32**D, **FIG. 32**E and **FIG. 32**F.

[**0210**] **FIG. 32A** is a fragmentary cross sectional view showing the step of forming a plurality of protruding electrodes **515** on a semiconductor device **513** that is one example of the first electronic component. First, on a stage **517** there is placed the semiconductor device **513** having a plurality of planar metal electrode pads **514** (the metal electrode pad **514** is one example of an electrode) that has a surface layer and is made of gold or aluminum, and the semiconductor device **513** is fixed to the stage **517** with use of an unshown fixing jig or by such method as sucking. Next, a metal fine line **570** made of gold or aluminum is passed through an electrode forming jig **516**, and the metal fine line **570** coming out from the top end of the jig **516** is formed into a spherical portion by discharging. Then, the spherical portion of the metal fine line **570** is pressed to the electrode pad **514** while heat, a load and a supersonic wave are being applied thereto. After that, the jig **516** is lifted up, which breaks the metal fine line **570** in the vicinity of an interface between a recrystallized region and an amorphous region in the spherical portion of the metal fine line **570**, and thereby a protruding electrode **515** is formed on the electrode pad **514** of the semiconductor device **513**. It is noted that the protruding electrodes **515** may be formed by plating, or printing, melting and hardening of a solder paste.

[**0211**] **FIG. 32B** is a fragmentary cross sectional view showing the step of leveling. The semiconductor device **513** having a plurality of protruding electrodes **515** formed in the previous step is fixed to the stage **519** and all the protruding electrodes **515** are pressed downward by a specified height while a load is being applied by a leveling tool **518**. This

makes it possible to level all the protruding electrodes **515** to have a uniform height. The face of the stage **519** to which the semiconductor device **513** is fixed, and the face of the leveling tool **518** that comes into contact with all the protruding electrodes **515** are planar.

[**0212**] **FIGS. 32C and 32D** are fragmentary cross sectional views showing the step of embedding the semiconductor device **513** in a sheet-substrate **503**, while **FIGS. 32E and 32F** are fragmentary cross sectional views showing the step of exposing the semiconductor device **513** to the sheet-substrate **503**. In these steps, there is used the same method as used in **FIGS. 31A, 31B, 31**C and **31**D of the ninth embodiment.

[**0213**] More specific examples of the method for manufacturing the semiconductor device-mounted component include a case of forming Au protruding electrodes on a bare IC chip that exemplifies the semiconductor device **513** with an external size of 2 mm×1.8 mm and a thickness of 0.18 mm that has two to ten units of square-shaped Al-plated lands whose one side is 80 μm, where a gold line with its diameter of 25 μm is used and preferable conditions are such that a current value is 30.0 mA, discharge time is 2.0 ms, ultrasonic output is 150 mW, bonding temperature is 150° C., and a bonding load is 70 g. In this conditions, the bump height is 60 to 80 μm. After the height is leveled to 40 to 60 μm, the electronic component is embedded in a sheet base substrate of polyethylene terephthalate with a thickness of 190 to 210 μm under the conditions of: resin temperature of 150 to 170° C.; a load of 40 to 50 kgf (392.4 to 490.5N) or pressure of approx. 2.9×106 Pa; and pressing time of 20 s to 150 s. Consequently, a maximum distance from the top end of the electrode to the surface of the sheet base substrate of the polyethylene terephthalate becomes 10 μm. After that, the electrodes are exposed from the surface of the sheet base substrate by the plasma etching or the polishing.

[**0214**] According to the tenth embodiment, since the semiconductor device **513** is embedded in the sheet-substrate **503**, it becomes possible to decrease the thickness of the sheet module that is the semiconductor device-mounted component, thereby enabling decrease of the thickness of the component. Further, the thin sheet module is softer than a conventional substrate, so that it enables to be used on a curved face or a place where bending operation is performed. Furthermore, since the semiconductor device **513** is built in the sheet-substrate **503**, a film formation area and a circuit pattern formation area on the surface of the substrate or the sheet-substrate **503** enables to be enlarged, which enables implementation of high functions and downsizing of the substrate.

[**0215**] (Eleventh Embodiment)

[**0216**] A method for manufacturing the electronic component-mounted component according to an eleventh embodiment of the present invention will be described with reference to **FIG. 33**A and **FIG. 33B**.

[**0217**] **FIG. 33**A and **FIG. 33B** are a fragmentary cross sectional view and a plane view showing a sheet module as one example of the electronic component-mounted component. The sheet module is formed such that, for example, the semiconductor device **513** having a plurality of protruding electrodes **515** formed by the same method as that in the tenth embodiment is embedded in a thermoplastic resin sheet base-substrate **503**D that exemplifies the base substrate having the through hole **548** exemplifying a through hole for electric connection that obtains electric connection by a thin coating and a conductive paste that are examples of conductors put on the surrounding of a hole formed by an NC puncher or a laser and having electric insulating. After that, a plurality of the protruding electrodes **515** are exposed by the polishing processing or the plasma discharge processing. Next, there are formed (or mounted) a thin-film capacitor **546** and a coil **547**, that are examples of the second electronic components, so as to be connected to the protruding electrodes **515**, respectively. It is noted that the through hole **548** is not necessary if a module sheet as a product fulfills the function only with one face (the face from which the protruding electrodes **515** are exposed in this case). The thin-film capacitor **546** is manufactured by forming two kinds of conductive films by sputtering or vapor deposition on the sheet base substrate **503**D so as to cover the protruding electrode **515** via a dielectric film. The coil **547** is manufactured on the sheet base substrate **503**D by printing solder paste or conductive paste on the sheet base substrate **503**D with use of a mask squeegee or by performing photolithography after plating. It is noted that a thin-film resist may be formed on the sheet base substrate **503**D. More specifically, circuit patterns that exemplifies a circuit component formed in the shape of a film, a metal thin-film capacitor **546**, the coil **547**, or a resist may be formed on the sheet base substrate **503**D by plating, ion plating, sputtering and deposition that exemplify methods for forming a conductor. Also the circuit patterns (the circuit patterns are also an example of the first circuit patterns) may be formed by printing a solder paste or a conductive adhesive on electrodes exposed from the surface of the base substrate and then by heating and hardening the same in a high-temperature furnace or a high-temperature stage.

[**0218**] According to the eleventh embodiment, in addition to the working effect of the above-described tenth embodiment, the semiconductor device **513** being built in the sheet-substrate **503**D is possible to enlarge the film formation area and the circuit pattern formation area (e.g., the area for forming the thin-film capacitor **546** and the coil **547**) on the surface of the substrate or the sheet-substrate **503**D, which enables implementation of high functions and downsizing of the substrate.

[**0219**] As a modified example of the eleventh embodiment, **FIGS. 34A, 34B, 34**C and **34**D are fragmentary cross sectional views and plane views showing the manufacturing process of the electronic component-mounted component in the case where nine units of the modules are manufactured at the same time. A thermoplastic resin sheet base-substrate **503**E having electric insulating used in the modified example (the sheet base-substrate **503**E is one example of the base substrate) is structured such that nine individual module areas **503***z* are integrally formed, and each of the individual module areas **503***z* corresponds to the sheet base substrate **503**D. Each of the individual module areas **503***z* has the through hole **548**.

[**0220**] The manufacturing process of the electronic component-mounted component is composed the steps of: collectively embedding nine semiconductor devices **513** in the nine individual module areas **503***z* of the thermoplastic resin sheet base-substrate **503**E having electric insulating; exposing electrodes **515** of each of the semiconductor devices **513**

from the surface of the sheet base-substrate **503**E by the polishing processing or the plasma processing; printing conductive adhesive on the sheet base-substrate **503**E and forming circuit patterns by formation of a metal film and the like; and cutting the component into pieces per module.

[**0221**] The step of collectively embedding the nine semiconductor devices **513** is basically performed in accordance with the tenth embodiment by the same method as the ninth embodiment, in which nine the semiconductor devices **513** are brought into contact with the press tool **504**, and while an arbitrary load is being applied toward the heating stage **505**, the nine semiconductor devices **513** are pressed simultaneously into the nine individual module areas **503***z* of the sheet base-substrate **503**E by the press tool **504**, as a consequence of which these nine semiconductor devices **513** are collectively and simultaneously embedded in the sheet base-substrate **503**E. Next, the press tool **504** is lifted up, and the sheet base-substrate **503**E with the nine semiconductor devices **513** embedded therein is detached from the heating stage **505** and cooled down to a room temperature, by which the sheet-substrate **503**E is hardened and the nine semiconductor devices **513** are embedded in the sheet-substrate **503**E.

[**0222**] The step of exposing the electrodes is also performed basically in accordance with the tenth embodiment by the same method as the ninth embodiment, in which a plurality of electrodes **515** of each of the semiconductor devices **513** are simultaneously and collectively exposed from the surface of the sheet base-substrate **503**E by the polishing processing and the plasma processing.

[**0223**] Further, the step of forming the circuit patterns is basically performed by the same method as the tenth embodiment, in which the circuit patterns are collectively and simultaneously formed by printing of conductive adhesive on the sheet base-substrate **503**E and formation of a metal film.

[**0224**] The cutting step is performed so as to cut the component into pieces so that each semiconductor device **513** is separated from each other per individual module areas **503***z*, i.e., per individual modules. The component is preferably cut into pieces with use of a dicing machine or a laser. It is noted that reference numeral **50** denotes a virtual cutting line for cutting the component into pieces per module.

[**0225**] According to the modified example of the eleventh embodiment, in addition to the working effect of the above-mentioned eleventh embodiment, there is implemented an effect of increasing productivity since unlike conventional batch-processing, collective embedding of a number of semiconductor devices **513** is achieved as well as collective exposure of the protruding electrodes **515** of a number of semiconductor devices **513** is enabled.

[**0226**] (Twelfth Embodiment)

[**0227**] The following description discusses a method for manufacturing a multilayer-laminated electronic component-mounted component according to a twelfth embodiment of the present invention.

[**0228**] In the manufacturing method, a sheet module **549** is formed by the steps of: embedding the semiconductor device **513**, that is one example of the electronic component and also one example of the first electronic component, in a thermoplastic resin sheet base-substrate **503**F having electric insulating (the sheet base-substrate **503**F is one example of the base substrate) by the method for manufacturing the electronic component-mounted component according to the previous embodiment; exposing the protruding electrodes **515** from the surface of the sheet base-substrate **503**F by the polishing processing and the plasma processing; and then forming the circuit patterns, the thin-film resist, the thin-film capacitor **546** and the like on a front face of the sheet base-substrate **503**F or on the both front and back faces thereof. Then, a plurality of the sheet modules **549** are superposed on top of each other and pressed for lamination.

[**0229**] More specifically, **FIG. 35** is a fragmentary cross sectional view showing a sheet module and the like for describing a lamination method for laminating a semiconductor device-mounted sheet modules **549** with electrodes of the semiconductor device being exposed by the polishing processing or the plasma processing. In the thermoplastic resin sheet base-substrate **503**F having the through hole **548**, the semiconductor device **513** is embedded, and then the protruding electrodes **515** of the semiconductor device **513** are exposed from the top face of the sheet base-substrate **503**F by the polishing processing and the plasma processing. Next, a thin-film capacitor **546** and a coil **547** made of a conductive paste are formed on the protruding electrodes **515**. On the back face of the sheet base-substrate **503**F, a thermoplastic resin sheet base-substrate **503**G having the semiconductor device **519** and having electric insulating as well as including a thin-film capacitor **522** and a coil **521** made of a conductive paste formed on the protruding electrodes **515** is aligned so as to enable electrical joining with the back face of the sheet base-substrate **503**F. Next, on the both faces thereof, protective sheets **523**, **524** having electric insulating (the protective sheets **523**, **524** are examples of a insulating protecting sheet) are placed and laminated in a thickness direction, and roll pressing is performed upward and downward by upward and downward rolls **540**, **541**. This forms a laminated electronic component built-in module.

[**0230**] As for the function and material of the protective sheets **523**, **524**, the protective sheets **523**, **524** are composed of thermoplastic resin that are preferably made of the same material as the thermoplastic resin sheet base-substrate **503** for the embedding but they may be made of other materials. Preferable materials include polyethylene phthalate, polyvinyl chloride, polycarbonate, and acrylonitrile styrene-butadiene. In **FIG. 35**, the sheet base-substrate **503**G is disposed on the lower face of the sheet base-substrate **503**F. Without being limited to this, the sheet base-substrate **503**G may be disposed on the upper face of the sheet base-substrate **503**F, or disposed on the both faces of the sheet base-substrate **503**F, and further a plurality of other sheet base-substrates may be laminated in the thickness direction on one face or the both faces of the sheet base-substrate **503**F.

[**0231**] According to the twelfth embodiment, in addition to the working effects of the ninth and the tenth embodiments, humidity resistance of the semiconductor devices **513**, **519** and the circuit patterns becomes excellent since the semiconductor devices **513**, **519** and the circuit patterns are covered by lamination of a plurality of the sheet base-substrates **503**F and **503**G. More specifically, the semiconductor devices **513**, **519** are not exposed to the air, so that they are less susceptible to oxidation or migration in the

electrode **515**, and wear thereof is prevented, which enables portable usage as a thin-film card and makes the component practicable.

[**0232**] Next description will be given of another embodiment of the present invention, in which the base substrate is embedded directly in the semiconductor device without leveling the protruding electrodes to have a uniform height.

[**0233**] **FIGS. 38A and 38B** are cross sectional views showing a method for directly embedding a semiconductor device (a bare IC chip) **513** as one example of the electronic component in the thermoplastic resin sheet base-substrate **503** without leveling the protruding electrodes to have a uniform height.

[**0234**] For comparison, **FIGS. 38A and 38B** are cross sectional views of the thermoplastic resin sheet-substrate **503** and the like for describing a method for embedding the semiconductor device in the thermoplastic resin sheet-substrate **503** whose protruding electrodes are leveled in advance. On a rigid stage **505**, there is placed the thermoplastic resin sheet-substrate **503**, on which the semiconductor device **513** having protruding electrodes **515***a*, **515***b* is placed with a electrode-side face thereof facing down, and the back face of the semiconductor device **513** is pressed while being heated by the hot pressing tool **504**. Since the protruding electrodes **515***a*, **515***b* of the semiconductor device **513** are already leveled, the heights of the protruding electrodes **515***a* and **515***b* are almost the same. Consequently, the semiconductor device **513** is embedded so that the faces of the semiconductor device **513** are almost paralleled to the surface of the stage **505**, and the electrodes **515***a*, **515***b* are easily exposed from the surface of the thermoplastic resin sheet-substrate **503**.

[**0235**] **FIGS. 39A and 39B** are cross sectional views of a thermoplastic resin sheet base-substrate and others for describing a method for directly embedding the semiconductor device **513** in the thermoplastic resin sheet base-substrate **503** without the leveling operation after formation of bumps. The heights of protruding electrodes **515***c*, **515***d* of the semiconductor device **513** is expressed as (the height of the electrode **515***c*)<(the height of the electrode **515***d*) due to variance after formation of the bumps. Consequently, the faces of the semiconductor device **513** are inclined from the surface of the stage **505**. If the semiconductor device **513** is pressed in this state, the top end thereof does not reach the surface of the thermoplastic resin sheet-substrate **503** and fails to be exposed therefrom like the protruding electrode **515***c* of **FIG. 39**B, or the top end of the protruding electrode falls down and is exposed in an irregular form like the protruding electrode **515***d*. In such exposure, the joining failure and shortage of the joining reliability occur in the next circuit formation step.

[**0236**] Accordingly, description will be given of an embedding method without the leveling with reference to **FIGS. 40A and 40B**.

[**0237**] As shown in **FIG. 40**A, by using a hot pressing tool **504**A having a mechanism of sucking the semiconductor device **513**, the semiconductor device **513** is embedded in the thermoplastic base substrate **503** while the back face of the semiconductor device **513** is being sucked. As the semiconductor device **513** is continuously sucked, the faces of the semiconductor device **513** are held parallel to the surface of the stage **505**. The protruding electrode **515***c* is pressed against the stage **505** that is a rigid member so as to be plastic-deformed. If the protruding electrode **515***c* is pressed till it is deformed to be shaped like shown in **FIG. 40**B, not only the protruding electrode **515***c* but also the protruding electrode **515***d* that is higher than the protruding electrode **515***c* are exposed from the surface of the thermoplastic resin sheet-substrate **503**. Since the faces of the semiconductor device **513** are always parallel to the surface of the stage **505**, the heights of the protruding electrodes **515***c* and **515***d* are always equal as shown in **FIG. 40B**. It is noted that in this method, the mechanism for sucking the semiconductor device **513** is necessary, which makes it impossible to interpose the release paper between the semiconductor device **513** and the press tool **504**A as a preventive measure for preventing the thermoplastic resin sheet-substrate **503** from being vitreous in heating operation and sticking on the press tool **504**A. It is therefore desirable to form the press tool **504**A from a material that is easily released from the thermoplastic resin sheet-substrate **503**, or the press tool **504**A is formed to be smaller than the semiconductor device **513**.

[**0238**] Next, **FIG. 41** is a schematic view showing one example of the apparatus for manufacturing an electronic component-mounted component according to yet another embodiment of the present invention. The apparatus is mainly composed of: a feeding mechanism **572** for feeding the thermoplastic resin sheet-substrate **503**; a semiconductor device feeding mechanism **567**; a recognition camera **573**; a transportation mechanism **578** for the semiconductor devices **513**; a semiconductor device inverting tool **579**; a temporal embedding stage **574**; an upper-side press tool **504** constituting a hot pressing mechanism **568** and a heating stage **505**; and a plasma etching mechanism **569**.

[**0239**] First, the thermoplastic resin sheet-substrates **503** are preferably fed by a roll feeding method or a sheet feeding method. **FIG. 41** shows the roll feeding method. First, roll-type thermoplastic resin sheet-substrates **503** are constantly fed without slack from the right side to the left side in **FIG. 41** by the feeding mechanism **572**.

[**0240**] The semiconductor devices **513** having the protruding electrodes **515** formed in advance on the electrode pads **514** are stored regularly in trays with the electrode-side face thereof facing up. These trays are stacked in multiple stages and placed in a feeding tray portion **571** of the semiconductor device feeding mechanism **567** that is an example of the electronic component feeding apparatus. It is noted that without being limited to this storing method, the semiconductor devices **513** may be stored in the form of a wafer.

[**0241**] Next, with use of a semiconductor device recognition camera as an example of the recognition apparatus for the semiconductor device inverting tool **579** as an example of the vertical inverting apparatus, there are recognized characteristic and patterns of the electrode-side face, and an outside diameter of the protruding electrodes of the semiconductor device **513** in the tray. Then, with use of a suction jig **579***a* of the semiconductor device inverting tool **579** having a sucking function, one face of the semiconductor device **513** placed in a tray, that is an electrode-side face, is sucked, and then the semiconductor device inverting tool **579** is rotated about a rotational axis for inverting the

semiconductor device **513** upside down so as to dispose the electrode-side face of the semiconductor device **513** face down.

[**0242**] Next, a transportation suction nozzle **578***a* of the semiconductor device transportation mechanism **578** as an example of the electronic component mounting apparatus is moved along a rail **578***c* to the upper side of the semiconductor device inverting tool **579**, where the transportation suction nozzle **578***a* is lowered to suck and hold the face of the semiconductor device **513** that is opposed to the face sucked by the suction jig **579***a* of the semiconductor device inverting tool **579**. Thus, one face of the semiconductor device **513** sucked by the transportation suction nozzle **578***a* of the semiconductor device transportation mechanism **578**, that is the electrode-side face, is placed face down.

[**0243**] Next, while the semiconductor device **513** is sucked by the transportation suction nozzle **578***a* of the semiconductor device transportation mechanism **578**, the transportation suction nozzle **578***a* of the semiconductor device transportation mechanism **578** is moved along the rail **578***c* to the upper side of the thermoplastic resin sheet-substrate **503** on the temporal embedding stage **574**. Next, after an embedding position of the thermoplastic resin sheet-substrate **503** placed on the temporal embedding stage **574** is recognized by the recognition camera **573**, the transportation suction nozzle **578***a* is lowered, and the semiconductor device **513** sucked by the transportation suction nozzle **578***a* is embedded in the embedding position of the thermoplastic resin sheet-substrate **503** on the temporal embedding stage **574**. Here, for preventing displacement of the embedded semiconductor device **513** during transportation, the transportation suction nozzle **578***a* preferably presses the semiconductor device **513** down by a specified amount for a short period of time while the transportation suction nozzle **578***a* is being heated. It is noted that the planar size of the transportation suction nozzle **578***a* is preferably the same size as the semiconductor device **513**.

[**0244**] Next, the thermoplastic resin sheet-substrate **503** placed on the temporal embedding stage **574** is moved to the upper side of the heating stage **505**, where the semiconductor device **513** is pressed in the thermoplastic resin sheet-substrate **503** for a specified period of time by the upper-side press tool **504** that is an example of the electronic component inserting apparatus. It is noted that the hot pressing mechanism **568** may be used in the air or in a vacuum. Also it is desirable to provide a multistage stacking mechanism capable of hot-pressing a plurality of the thermoplastic resin sheet-substrates **503** in the state of being stacked in a superposing direction of the semiconductor device **513** on the thermoplastic resin sheet-substrate **503**, as well as a rotating stage mechanism and a temperature profile controller supporting divided steps such as a preheating step, a full-heating step and a cooling step. It is noted that the hot pressing mechanism **568** is preferably capable of controlling contact-starting position, pressing-in end position, lowering speed, lifting speed and the like for the embedding the semiconductor device **513** on the thermoplastic resin sheet-substrate **503**.

[**0245**] Next, the thermoplastic resin sheet-substrate **503** on the heating stage **505** is transported to the plasma etching mechanism **569** that is an example of an electrode exposing apparatus, where electrodes **515** of the semiconductor device **513** are exposed from the thermoplastic resin sheet-substrate **503** by the plasma etching. In the plasma etching mechanism **569**, the plasma-discharge upper-side electrode **511** is disposed on the upper side of the thermoplastic resin sheet-substrate **503** for sucking the thermoplastic resin sheet-substrate **503** with no space between the upper-side electrode **511** and the thermoplastic resin sheet-substrate **503**. The plasma-discharge lower-side electrode **512** is disposed on the lower side of the thermoplastic resin sheet-substrate **503** so as to be parallel to the surface of the plasma-discharge upper-side electrode **511**. Between the both electrodes **511** and **512**, it is necessary to provide a high frequency generating source for applying high voltage and a matcher for attaining impedance matching between the plasma and the source. Also, it is desirable to provide pipes for introducing oxygen gas, hydrofluoric acid, argon gas and the like, and a gas cylinder for storing the corresponding gas. Further, it is desirable to provide a pump for creating a high vacuum such as an oil-sealed rotary vacuum pump, an oil diffusion pump and a cryopump, as well as a vacuum gauge for confirming attainment of a vacuum. It is noted that the plasma etching mechanism **569** may be replaced by a polishing function. In the case of the polishing, creation of a vacuum is not necessary.

[**0246**] The above structure enables continuous execution of temporal embedding, pressing-down, and electrode exposure of the semiconductor device **513** against the thermoplastic resin sheet-substrate **503**.

[**0247**] Next, description will be given of the case of a stack module in which a plurality of memory chips are stacked in multiple stages as still another embodiment of the present invention.

[**0248**] **FIG. 42** is a cross sectional view showing a built-in package module in which a stack module **583** formed by stacking two memory chips (herein a first semiconductor device **513**A and a second semiconductor device **513**B, both of which are examples of the electronic components) is mounted on a printed circuit board **585**. **FIG. 43** is a flowchart showing a method for manufacturing the package module.

[**0249**] The built-in package module is structured such that a stack module **583** is mounted on the printed circuit board **585** having circuit patterns provided in advance. Substrate electrodes **580**, **580***a*, **580***b* of the built-in package module are joined to a mother board unshown in **FIG. 42** via solder or conductive adhesive to establish electric joining to the mother board. For example, electrodes **515***e*, **515***f* of the first semiconductor device **513**A are electrically joined to the electrodes **580***a*, **580***b* via circuit patterns **586** on the surface of the stack module **583**, through holes **588** of the stack module **583** and electrodes **581** of the printed circuit board **585**.

[**0250**] In the manufacturing process of the stack module **583**, first in the step S31, the first semiconductor device **513**A is embedded in a first thermoplastic resin sheet base-substrate **503**A, and then in the step S32, electrodes **515***e*, **515***f* of the first semiconductor device **513**A are exposed by the plasma etching or the polishing. The plasma etching may be applied to either the entire surface of the first thermoplastic resin sheet base-substrate **503**A or the surface of the first thermoplastic resin sheet base-substrate **503**A around the electrodes.

[**0251**] Also in the step S**33**, conductive through-holes **589** are formed in a second thermoplastic resin sheet base-substrate **503**B with use of an NC puncher. Its hole diameter is preferably 0.1 to 1.0 mm. Next in the step S**34**, circuit patterns **587** are printed by such method as sputtering, plating and printing of conductive adhesive.

[**0252**] In the step S**35**, by the same method, the second semiconductor device **513**B is embedded in the second thermoplastic resin sheet base-substrate **503**B, and in the step S**36**, electrodes **515***g* of the second semiconductor device **513**B are exposed. The step S**31** through S**34** and the step S**35** through S**36** may be performed separately or simultaneously.

[**0253**] Next in the step S**37**, the first thermoplastic resin sheet base-substrate **503**A is superposed on the second thermoplastic resin sheet base-substrate **503**B, and the base-substrates are hot-pressed and fixed in the laminated state. Then in the step S**38**, there are formed through holes **588** that passes through the first thermoplastic resin sheet base-substrate **503**A and the second thermoplastic resin sheet base-substrate **503**B.

[**0254**] Next in the step S**39**, circuit patterns **586** are printed on the upper face of the first thermoplastic resin sheet base-substrate **503**A, and the through holes **588** are filled with electric conductive material. Thus, the stack module **583** is completed.

[**0255**] Finally in the step S**40**, the printed circuit board **585** with the circuit patterns provided in advance made of, for example, a ceramics, a glass epoxy resin and a resin multilayer substrate (e.g., ALIVH (Any Layer Interstitial Via Hole) made by Matsushita Electric Industrial Co., Ltd.) and the stack module **583** are hot-pressed to form the built-in package module.

[**0256**] **FIG. 44** is a cross sectional view showing a memory card composed of: four layers of sheet modules for memory **591** made of layers of thermoplastic resin sheet base-substrates **503**C incorporating two semiconductor devices (bare IC chips) for memory **513**C exemplifying the electronic components; and one layer of a sheet module for controller **592** made of a thermoplastic resin sheet base-substrate **503**D (the sheet base-substrate **503**D is one example of the base substrate) incorporating one semiconductor device (a bare IC chip) for controller **513**D exemplifying the electronic component in still another embodiment of the present invention. Since one semiconductor device for memory **513**C has a capacity of 64 MB, one layer of the sheet module for memory **591** has a capacity of 128 MB and the total four layers thereof have a recording capacity of 512 MB. **FIG. 45** is a flowchart showing the manufacturing process of the memory card.

[**0257**] For example, the memory card of **FIG. 44** is composed of: four layers of the sheet modules for memory **591** incorporating two semiconductor devices for memory **513**C of 16 mm long×8 mm wide×0.080 mm thick; and one layer of the sheet module for controller **592** incorporating one semiconductor device for controller **513D** that is a square whose one side is 7.8 mm and whose thickness is 0.200 mm, in which each layer is electrically joined via conductive paste **593** and the like. It is noted that on each electrode of the semiconductor devices **513**C, **513**D, protruding bumps with a height of 0.04 mm are formed.

[**0258**] Following description discusses one example of a method for manufacturing a memory card.

[**0259**] First in the step S**41**, through holes **594** of ϕ 0.2 mm are formed in specified positions of the thermoplastic resin sheet base-substrate **503**C, that is, for example, a thermoplastic polyimide sheet base-substrate **503**C, by means of an NC puncher or a laser.

[**0260**] Next in the step S**42**, two semiconductor devices for memory **513**C are simultaneously embedded in the thermoplastic resin sheet base-substrate for memory **503**C, whereas one semiconductor device for controller **513**D is embedded in the thermoplastic resin sheet base-substrate for controller **503**D.

[**0261**] Next in the step S**43**, bump electrodes **515** of the semiconductor devices **513**C, **513**D are exposed from the surface by plasma etching. In the plasma etching, it is desirable to use oxygen plasma.

[**0262**] Next in the step S**44**, each of the thermoplastic resin sheet base-substrate for memory **503**C and the thermoplastic resin sheet base-substrate for controller **503**D is plated with Ni layer of approx. 1 μm by electroless Ni plating, and then dipped in an electrolytic plating solution to form Cu layer of 15 μm. Then, in the step of photolithography, circuit patterns **595** joined to the electrodes **515** are formed. Here, the surrounding of the through holes **594** are also plated at the same time so as to obtain electric joining. It is noted that this step may be fulfilled by printing of conductive adhesive or sputtering. After that, on casing-electrodes **596** of a casing **597**A, a printing mask is mounted and then there is printed conductive paste **598** such as solder paste and conductive adhesives typified by silver paste, copper paste and silver palladium paste by means of a squeegee. The thickness of the conductive paste **598** after printing is preferably 0.020 to 0.030 mm.

[**0263**] After that in the step S**45**, the sheet module for controller **592** is mounted on the casing **597**A, where the casing-electrodes **596** of the casing **597**A are electrically joined to the circuit patterns **595** of the thermoplastic resin sheet base-substrate for controller **503**D via the conductive paste **598**, and the conductive paste **598** is hardened in a hardening furnace or a reflow furnace.

[**0264**] Next, on top of electrodes **599** on the upper side of the sheet module for controller **592**, there is printed conductive paste **593** such as solder paste and conductive adhesive typified by silver paste, copper paste and silver palladium paste, on which the forth-layer or the lowermost sheet module for memory **591** is mounted and hardened. Next, on electrodes on the upper side of the fourth-layer sheet module for memory **591**, there is printed conductive paste **593** such as solder paste and conductive adhesive typified by silver paste, copper paste and silver palladium paste, on which the third-layer sheet module for memory **591** is mounted and hardened. Next, on electrodes on the upper side of the third-layer sheet module for memory **591**, there is printed conductive paste **593** such as solder paste and conductive adhesive typified by silver paste, copper paste and silver palladium paste, on which the second-layer sheet module for memory **591** is mounted and hardened. Next, on electrodes on the upper side of the second-layer sheet module for memory **591**, there is printed conductive paste **593** such as solder paste and conductive adhesive

typified by silver paste, copper paste and silver palladium paste, on which the first-layer or the uppermost sheet module for memory **591** is mounted and hardened.

[**0265**] Finally in the step S**46**, a casing cover **597**B is put over the sheet modules **591**, **592**, by which the memory card is formed.

[**0266**] **FIGS. 46A, 46B** and **46**C are, respectively, a top view, a bottom view and a cross sectional view each showing an intermediate layer of a non-contact IC card manufactured by a method for manufacturing a non-contact IC card according to yet another embodiment of the present invention. **FIG. 47** is a flowchart showing the method for manufacturing the non-contact IC card. **FIGS. 48A, 48B, 48**C, **48**D, **49**E, **49**F and **49**G are process charts each showing the method for manufacturing a non-contact IC card. The non-contact IC card enables data write and read for a short period of time.

[**0267**] The non-contact IC card shown in **FIGS. 48A, 48B** and **48**C incorporates a semiconductor device (bare IC chip) **513**E that is data rewritable FeRAM (the semiconductor device **513**E is an example of the electronic component), and a coil **556** serving as an antenna is printed on the surface of the intermediate layer.

[**0268**] In the manufacturing process of the non-contact IC card, first in the step S**50** and **FIG. 48**B, two through holes of 0.200 mm in diameter (**554***a*, **554***b*) are formed in a thermoplastic resin sheet-substrate **503**H having a sheet thickness of 0.100 mm, e.g., a polyethylene terephthalate sheet-substrate **503**H (the sheet-substrate **503**H is one example of the base substrate), by means of an NC puncher.

[**0269**] Next in the step S**51** and **FIG. 48C, a** jumper line **553** is formed so as to cover the through holes **554***a*, **554***b* by printing of conductive paste, and hardened. Hardening conditions in the case of using silver paste is 110° C. and 10 minutes.

[**0270**] Next, in the step S**54** and **FIG. 48**D, the semiconductor device **513**E (see **FIG. 48A**) of FeRam with dimensions of 4 mm long×6 mm wide×0.080 mm thick having gold protruding electrodes of 0.040 mm high previously formed in the four corners in the step S**52** and leveled in the step S**53** is embedded in the sheet-substrate **503**H made of polyethylene terephthalate having the sheet thickness of 0.100 mm. Then in the step S**55** and **FIG. 49**E, the electrodes **515***h* of the semiconductor device **513**E are collectively exposed by plasma etching. The step S**50** through S**51** and the step S**52** through S**53** may be performed separately or at the same time.

[**0271**] After that, in the step S**56** and **FIG. 49F, a** conductive paste is printed and hardened to form the coil **556** serving as the antenna so as to be in contact with the electrodes **515***h*.

[**0272**] Finally in the step S**57** and **FIG. 49**G, thermoplastic resins, e.g., polyethylene terephthalate sheets **555**, are superposed on the both sides of the thermoplastic resin sheet-substrate **503**H, and lamination-pressing is executed to form the superposed sheets into a card (see **FIGS. 46C, 46G**).

[**0273**] Then, in the step S**58**, patterns are printed, and in the step S**59**, the sheets are cut out in a card size with a blanking apparatus. Thus, a non-contact IC card is completed.

[**0274**] It is noted that appropriately combining arbitrary embodiments among the above-described various embodiments makes it possible to implement the effects of each embodiment.

[**0275**] As described above in detail, according to the first aspect, on a circuit formation face of the base substrate having a first electronic component inserted therein, the first circuit patterns are formed so as to be electrically joined to each of the electrodes of the first electronic component, and then a second electronic component is mounted on the first circuit patterns. Therefore, in the case where the first electronic component and the second electronic component are disposed and mounted in the thickness direction of the base substrate, the thickness of the electronic component-mounted component may be decreased by the thickness of the base substrate, thereby making it possible to satisfy recent product needs of reduced thickness.

[**0276**] Also, since the second electronic component is surface-mounted on the first circuit patterns on the base substrate, it is not necessary to place wire-bonding electrodes in the peripheral portion of the electronic component, which makes it possible to use the second electronic component of arbitrary sizes.

[**0277**] Further, since there is no limitation of the position of the electrodes of the second electronic component, the types of the electrodes are not limited either, which makes it possible to stack area pad-type semiconductor devices.

[**0278**] Also, according to the second aspect of the present invention, the first electronic component is inserted in the base substrate such that each of the electrodes of the first electronic component is exposed from the circuit formation face of the base substrate, that is the surface of the base substrate on which the first circuit patterns are formed. This facilitates and ensures establishment of the electric connection between each of the electrodes of the first electronic component and the first circuit patterns. Therefore, the electronic component-mounted component capable of obtaining the effect of the first embodiment may be manufactured easily and certainly.

[**0279**] Also, according to the other aspects of the present invention, further the electronic component-mounted component is lamination-processed from the other side of the electronic component-mounted component, so that the first electronic component inserted in the electronic component-mounted component may be sealed, thereby making it possible to provide a module more excellent in moisture resistance.

[**0280**] Also, in the case where a first substrate and a second substrate are provided, generally-used conventional circuit boards may be used as these substrates. Consequently, conventional printing technology and reflow technology in the surface mounting field is applicable, and therefore a degree of difficulty in module formation may be lowered.

[**0281**] Further, the electric connection between each of the electrodes of the first electronic component and the first circuit patterns is established such that the first circuit patterns are electrically connected to conductive through-holes having conductors inside thereof which are formed so as to pass through the base substrate in a thickness direction, thereby enabling mounting of components on the both faces

of the base substrate. Thus, establishing the electric connection by utilizing the through holes formed in the base substrate makes it possible to adopt various configurations in superposing the second electronic component, the first substrate, the second substrate, on the electronic component-mounted component.

[0282] Also, the first substrate and the second substrate, and the electronic component-mounted component are superposed on top of each other with use of binder, which enables easy superposition, thereby making it possible to manufacture the electronic component-mounted component having more diverse superposing configurations.

[0283] Also, according to the twentieth aspect of the present invention, in the case where each of the electrodes of the first electronic component in the state of being inserted in the base substrate are not exposed from the surface of the base substrate, any one of or both the polishing processing and the plasma discharge processing are performed, so that each of the electrodes of the first electronic component inserted in the base substrate may be exposed from the surface of the base substrate. This makes it possible to form the first circuit pattern so as to be electrically connected to the exposed electrodes with reliability.

[0284] More specifically, when the formation thickness of the base substrate is larger than the formation thickness of the first electronic component, inserting the first electronic component in the base substrate results in inserting each of the electrodes of the first electronic component in the base substrate. However, by applying the polishing processing or the plasma discharge processing to the surface of the base substrate, each of the electrodes of the first electronic component may be exposed.

[0285] Therefore, when the electrodes of the first electronic component in the state of being inserted in the base substrate are exposed from the surface of the base substrate, the circuit patterns are formed without executing any step, whereas when the electrodes are not exposed, the polishing processing or the plasma discharge processing is applied to ensure formation of the first circuit patterns and manufacturing of the electronic component-mounted component.

[0286] Also, as shown in the above-described various aspects of the present invention, since the thickness of the electronic component-mounted component may be decreased, it becomes possible to provide the electronic component-mounted component such as sheet modules which are softer than a conventional substrate so as to be used on a curved face or a place where bending operation is performed.

[0287] Further, according to still another aspect of the present embodiment, in the case where a semiconductor device (bare IC chip) as an example of the first electronic component is inserted in the base substrate, a film formation and circuit pattern formation area on the surface of the base substrate may be enlarged, which makes it possible to provide the electronic component-mounted component capable of implementing high function and downsizing. Further, there is implemented an effect of increasing productivity since unlike conventional batch-processing, a plurality of the first electronic components may be collectively inserted in the base substrate, and each of the electrodes of each of the first electronic components may be collectively exposed from the surface of the base substrate.

[0288] Although the present invention has been fully described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. Such changes and modifications are to be understood as included within the scope of the present invention as defined by the appended claims unless they depart therefrom.

What is claimed is:

1. A method for manufacturing an electronic component-mounted component, comprising of:

inserting a first electronic component in a base substrate;

forming a first circuit patterns, which are electrically connected to a plurality of electrodes of the inserted first electronic component, on a circuit formation face of the base substrate and then establishing electrically connecting between each of the electrodes and the first circuit pattern; and then

mounting a second electronic component on the first circuit patterns of the base substrate.

2. The method for manufacturing an electronic component-mounted component as defined in claim 1,

wherein the first electronic component is inserted in the base substrate so that each of the electrodes of the first electronic component is exposed from the circuit formation face of the base substrate.

3. The method for manufacturing an electronic component-mounted component as defined in claim 1, further comprising of: after inserting the first electronic component in the base substrate and forming the first circuit patterns and before mounting the second electronic component, performing lamination processing for disposing an insulating protection sheet on an opposite face side opposed to the circuit formation face of the base substrate.

4. The method for manufacturing an electronic component-mounted component as defined in claim 1, further comprising of superposing the base substrate and a first substrate, which has third circuit patterns and fourth circuit patterns opposed to each other and has first substrate through holes having conductors inside thereof for electrically connecting the third circuit patterns and the fourth circuit patterns, in thickness direction of the base substrate and the first substrate, so that the fourth circuit patterns of the first substrate are electrically connected to a plurality of electrodes of the second electronic component mounted on the base substrate.

5. The method for manufacturing an electronic component-mounted component as defined in claim 1, wherein the electric connection between each of the electrodes of the first electronic component and the first circuit patterns is established so that the first circuit patterns are also electrically connected to conductive through-holes which are formed to penetrate through the base substrate in its thickness direction and that have conductors inside thereof.

6. The method for manufacturing an electronic component-mounted component as defined in claim 5, further comprising of:

superposing the base substrate with the first electronic component inserted therein and the first circuit patterns formed thereon and a second substrate, which has fifth circuit patterns and sixth circuit patterns opposed to

each other and has second substrate through holes for electrically connecting the fifth circuit patterns and the sixth circuit patterns, in thickness direction of the base substrate and the second substrate, so that the sixth circuit patterns of the second substrate are electrically connected to the through holes of the base substrate; and then

mounting a third electronic component on the fifth circuit patterns.

7. The method for manufacturing an electronic component-mounted component as defined in claim 5, wherein the electric connection between each of the electrodes of the first electronic component and the first circuit patterns is established so that the first circuit patterns are also electrically connected, via the through holes, to second circuit patterns which are formed on an opposite face side opposed to the circuit formation face and which are electrically connected to the through holes.

8. The method for manufacturing an electronic component-mounted component as defined in claim 7, further comprising of mounting a third electronic component on the second circuit patterns.

9. The method for manufacturing an electronic component-mounted component as defined in claim 6, further comprising of: stacking a plurality of the base substrates with the first electronic component inserted therein and the first circuit patterns are formed thereon; and superposing the stacked base substrates and the second substrate.

10. A method for manufacturing an electronic component-mounted component, comprising of:

inserting a first electronic component in a base substrate;

forming first circuit patterns, which are electrically connected to a plurality of electrodes of the inserted first electronic component, on a circuit formation face of the base substrate for establishing electric connection between each of the electrodes and the first circuit patterns; and then

superposing the base substrate and a first substrate, which has third circuit patterns and fourth circuit patterns opposed to each other and has first substrate through holes having conductors inside thereof for electrically connecting the third circuit patterns and the fourth circuit patterns, in thickness direction of the base substrate and the first substrate, so that the fourth circuit patterns of the first substrate are electrically connected to the first circuit patterns of the base substrate.

11. The method for manufacturing an electronic component-mounted component as defined in claim 10,

wherein the first electronic component is inserted in the base substrate so that each of the electrodes of the first electronic component is exposed from the circuit formation face of the base substrate.

12. The method for manufacturing an electronic component-mounted component as defined in claim 10, further comprising of:

superposing the base substrate with the first electronic component inserted therein and the first circuit patterns formed thereon and the first substrate and then establishing electrically connecting between the fourth circuit patterns and the first circuit patterns; and then

mounting a second electronic component on the third circuit patterns.

13. The method for manufacturing an electronic component-mounted component as defined in claim 10, further comprising of mounting a second electronic component on the third circuit patterns prior to establishing the electric connection between the fourth circuit patterns of the base substrate and the first circuit patterns of the first substrate.

14. The method for manufacturing an electronic component-mounted component as defined in claim 10, further comprising of:

after inserting the first electronic component in the base substrate and forming the first circuit patterns, performing lamination processing for disposing a insulating protection sheet on an opposite face opposed to the circuit formation face of the base substrate; and

establishing electric connection between the first circuit patterns of the lamination-processed base substrate and the fourth circuit patterns.

15. The method for manufacturing an electronic component-mounted component as defined in claim 10, wherein the electric connection between each of the electrodes of the first electronic component and the first circuit patterns is established so that the first circuit patterns are also electrically connected to conductive through-holes which are formed to penetrate through the base substrate in its thickness direction and that have conductors inside thereof.

16. The method for manufacturing an electronic component-mounted component as defined in claim 15, further comprising of:

superposing the base substrate with the first electronic component inserted therein and the first circuit patterns formed thereon and a second substrate, which has fifth circuit patterns and sixth circuit patterns opposed to each other and has second substrate through holes for electrically connecting the fifth circuit patterns and the sixth circuit patterns, in thickness direction of the base substrate and the second substrate, so that the sixth circuit patterns of the second substrate are electrically connected to the through holes of the base substrate; and then

mounting a third electronic component on the fifth circuit patterns.

17. The method for manufacturing an electronic component-mounted component as defined in claim 10, wherein the base substrate and the first substrate is superposed via binder.

18. The method for manufacturing an electronic component-mounted component as defined in claim 16, wherein the first substrate and the second substrate are superposed on the base substrate via binder.

19. An electronic component-mounted component manufactured by the method for manufacturing an electronic component-mounted component as defined in claim 1.

20. The method for manufacturing an electronic component-mounted component as defined in claim 1, further comprising of, after inserting the first electronic component in the base substrate, exposing each of the electrodes of the inserted first electronic component from a surface of the base substrate by either one of or both polishing processing and plasma discharge processing.

21. The method for manufacturing an electronic component-mounted component as defined in claim 20, further comprising of:

before inserting the first electronic component in the base substrate, forming a protruding electrode on each of a plurality of electrodes of a semiconductor device as the first electronic component; then

inserting the semiconductor device in the base substrate with each of the protruding electrodes leveled to have a uniform height or without leveling operation; and

exposing each of the protruding electrodes from a surface of the base substrate.

22. The method for manufacturing an electronic component-mounted component as defined in claim 20, further comprising of, after exposing each of the electrodes of the first electronic component from the surface of the base substrate, forming a conductive film on each of the exposed electrodes instead of forming the first circuit patterns and mounting the second electronic component, for forming circuit components.

23. The method for manufacturing an electronic component-mounted component as defined in claim 20, further comprising of:

after exposing each of the electrodes of the first electronic component from the surface of the base substrate, printing solder paste or conductive adhesive on each of the exposed electrodes; and then

heat-hardening the electrodes in a high-temperature furnace or in a high-temperature stage for forming the first circuit patterns.

24. The method for manufacturing an electronic component-mounted component as defined in claim 20, further comprising of:

collectively inserting a plurality of the first electronic components in the base substrate;

exposing each of the electrodes of each of the first electronic components from the surface of the base substrate; and

cutting the base substrate into pieces so that each of the first electronic components is separated from each other.

25. A manufacturing method of an electronic component-mounted component for manufacturing a multilayer-laminated electronic component-mounted component comprising of: after manufacturing the electronic component-mounted component by the method for manufacturing the electronic component-mounted component as defined in claim 22, superposing on one face or both faces of the electronic component-mounted component, a plurality of the electronic component-mounted components or the base substrates in thickness direction thereof; and disposing a insulating protection sheet on both superposed front and back faces.

26. An electronic component-mounted component manufactured by the method for manufacturing an electronic component-mounted component as defined in claim 20.

27. An electronic component-mounted component, comprising:

a base substrate; and

an electronic component inserted in the base substrate with a plurality of electrodes being exposed from a surface of the base substrate by either one of or both polishing processing and plasma discharge processing.

28. The electronic component-mounted component as defined in claim 27, further comprising a circuit component formed by forming a conductive film on each of the electrodes exposed from the surface of the base substrate.

29. An apparatus for manufacturing an electronic component-mounted component, comprising:

an electronic component feeding apparatus for feeding a base substrate and an electronic component;

a vertical inverting apparatus for sucking the electronic component and then inverting the electronic component vertically;

an electronic component mounting apparatus for mounting the electronic component on the base substrate;

an electronic component inserting apparatus for inserting the electronic component in the base substrate; and

an electrode exposing apparatus for exposing each of the electrodes from a surface of the base substrate by using either one of or both plasma discharge processing and polishing processing.

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