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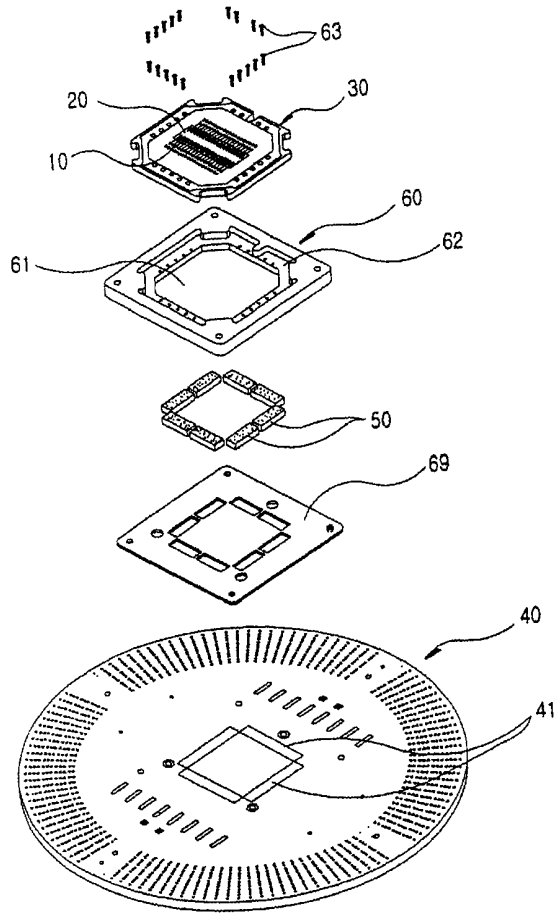
[Continued on next page]

(54) Title: PROBE CARD



(57) Abstract: This invention relates to a probe card manufactured by the steps of: attaching an insulator board, which is made of a silicone glass material and has a plurality of fine probes formed through an etching process, to a circuit board; bonding the fine probes to the circuit board with wires to connect circuitally; and circuitally connecting the circuit board to a main circuit board using a pad in which metal threads are implanted finely, thereby improving productivity of the probe card having the fine probes. The insulator board having the fine probes touching a circuit element which is the subject of measurement, the circuit board to which the insulator board is attached and which has a plurality of terminals connected to the probes with the wires in the one-to-one correspondence, the main circuit board connected to an exploring equipment which transfers measurement signal to the circuit element, and the pad placed between the circuit board and the main circuit board are made of insulating material. The numerous metal threads, which are implanted and projected from the lower surface of the circuit board and the upper surface of the main circuit board, connect the circuit boards circuitally.

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PROBE CARD

Technical Field of the Invention

The present invention relates to a probe card for checking electrical characteristics of a micro electronic device, such as a semiconductor wafer, and more particularly, to a probe card enabling a plurality of probes contacting with a contact point of an electric element to be manufactured to have higher precision and solidity by etching a semiconductor, and further achieving improvement in an assembling process thereof by connecting a circuit board on which the fine probes are mounted to a main board in an easier manner.

Background Art

Generally, when manufacturing an electrical circuit device, such as a semiconductor integrated circuit device, it is checked if the whole or partial electrical characteristics of the electrical circuit device are identical to those on a design during manufacturing the device, after manufacturing the device and before bonding a lead frame thereto. Mostly, a probe station is used to perform these tests, and a probe card is mounted thereon. The probe card serves to connect portions generating a variety of electrical signals within the probe station with contact points between a single or a plurality of elements formed on a semiconductor wafer.

The conventional method shown in FIG. 3 is the called a horizontal type or tungsten needle type. With this method, the measurement is executed by steps of fixing a probe 2, which is constituted of the tungsten needle and the end of which is made sharp; and contacting an end point thereof with a contact point 4 of the

subject to be measured. Since an electrical contact point of a recent semiconductor device is becoming smaller, however, the contact point having the size below tens of micrometers are arranged in dozens per one device having an interval of tens micrometer therebetween.

In the conventional measuring method, since a tungsten needle used as the probe has a thickness ranging to hundreds of micrometers, it is impossible to measure the contact point adjacent to the probe or to measure all wanted circuit patterns. Moreover, since size of the contact point is so minute, it is also difficult to install the probe on a position of the contact point to be precisely contacted with each other.

To overcome the above defects, a vertical type has been presented. In the vertical type, fine probes are arranged on a circuit board, such that the plurality of probes are installable to have a narrow interval therebetween. Further, length of the probes is short, such that electric efficiencies of the probe card manufactured in this way are highly enhanced. The important thing in manufacturing the vertical type probe is that all the probes installed ought to contact with the contact point of the subject of measurement.

For this, each probe should compressively contact with the contact point at a pressure over a predetermined value to ensure the contact with contact point, and the probe should have superior flatness and elasticity over a predetermined level to also ensure uniform arrangement of apexes of the manufactured probes.

If this probe has an elasticity high enough to create an elastic deformation, in case that there is a minute error on the flatness of the apex of the probe or an error on the contact point of the subject of measurement, and even in case that a semiconductor wafer on which the device is formed is not completely flat but has a slight distortion, a probe card can be used to execute a required electrical measurement. Manufacturing methods by using above method are disclosed in

U.S. Patent Nos. 4,961,052, 5,172,050, 5723,347, and so on.

Disclosure of the Invention

The inventor of the present invention has filed the application and assigned the Korean Patent Application No. 98-41311, which discloses a probe card realized by performing the steps of manufacturing vertical probes with required mechanical characteristics, such as elastic deformation and strength and attaching the probes on appropriate positions on an insulator board in a high density. In the disclosure, the probes attached to the probe card should measure electric efficiencies of a subject of measurement by being contacted with a contact point of the subject of measurement, and there should not be generated any leakage current between the probes. The probes should be returned into their original forms after the measurement and there should not occur any deformation during a predetermined life (for example, ten thousands of contacts) of the probe card.

The probe card disclosed in the above Korean Patent Application filled by the present inventor completely satisfies the aforementioned conditions, and the present invention is a more detailed embodiment of the previously filed application in Korea. The objective of the present invention is to provide a probe card manufactured by performing the steps of attaching an insulator board having a plurality of fine probes formed through an etching process, to a circuit board; bonding the fine probes to the circuit board with wires to connect circuitally; and circuitally connecting the circuit board to a main circuit board using a pad in which metal threads are implanted finely, thereby improving productivity of the probe card having the fine probes.

To achieve the above object, there is provided a probe card according to the present invention, comprising an insulator board on which a plurality of probes

contacting with a subject of measurement are formed; a circuit board attached to the insulator board, wherein terminals are connected to the probes in a one-to-one correspondence with wires; a main circuit board connected to a probe station, which transfers a measurement signal to the subject of measurement; a pad made of an insulating material, interposed between the circuit board and the main circuit board, and having a plurality of metal threads, which project from a lower surface of the circuit board and from an upper surface of the main circuit board to circuitally connect both the circuit boards.

Brief Description of the Drawings

Further objects and advantages of the invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a plan view of a conventional probe card;

FIG. 2 is a sectional view of the conventional probe card;

FIG. 3 is a schematic view illustrating a probing process of the conventional probe card;

FIG. 4 is an exploded cross view of a probe card according to the present invention;

FIG. 5 is a plan view of the probe card according to the present invention;

FIG. 6a and FIG. 6b are sectional views illustrating a state where the probe card according to the present invention is assembled;

FIG. 7 is a plan view of a circuit board in the probe card according to the present invention;

FIG. 8 is a cross view of the circuit board in the probe card according to the present invention;

FIG. 9a is a sectional view of the circuit board in the probe card according to the present invention;

FIG. 9b is an enlarged plan view of the probe card according to the present invention; and

FIG. 10a and FIG. 10b are sectional views illustrating a state where probes of the probe card according to the present invention are operated.

Best Modes For Carrying Out The Invention

A preferred embodiment of the present invention will be described herein below with reference to the accompanying drawings. In the following description, well-known functions or constructions are not described in detail since they would obscure the invention in unnecessary detail.

FIG. 4 is an exploded cross view of a probe card according to the present invention and FIG. 5 is a plan view of the probe card according to the present invention. The probe card according to the present invention includes an insulator board 20 having probes 10 contacting with an electrical contact point on a semiconductor wafer; a circuit board 30 attached to the insulting board 20 and circuitally connected to the probes 10; and a main circuit board 40 connected to a probe station; and a frame coupling the circuit board 30 and the main circuit board 40.

The probes 10 formed on the insulator board 20 are manufactured by etching a semiconductor. The process of manufacturing the probes 10 will explained herein below.

The insulator board 20 is made of a glass material and has a plurality of passageways 21, which pass through upper and lower sides of the insulator board 20 perpendicularly to a direction of length of the insulator board 20. The probes 10

are symmetrically formed on an upper surface of the insulator board 20 in a back and forth direction, and are provided between the respective passageways 21. The probes 10 provided between the passageways 21 are lined up in one direction. Here, the insulator board 20 and the circuit board 30 are bonded to each other with an adhesive.

The circuit board 30 is fastened to the main circuit board 40 by virtue of the frame 60. The frame 60 may be varied depending on a shape of the device. According to the present invention, however, the frame 60 is of a square shape. The frame 60 is provided with support jaws 62 inside thereof, with the circuit board 30 being inserted into the jaws 62. The jaws 62 are provided with passways 61 on an inner periphery thereof. The passways 61 pass through upper and lower sides of the jaws, such that a lower surface of the circuit board 30 is exposed toward the main circuit board 40. The circuit board 30 is coupled to the jaws 62 of the frame 60 with screws 63, and the frame 60 and the main circuit board 40 are interconnected to each other with bolts 64 and nuts 65.

FIG. 8 is a cross view of the circuit board in the probe card according to the present invention. Each of the probes 10 attached to the insulator board 20 has an apex 11 at a tip thereof and a coating layer coated with tungsten, or the likes, is formed on surfaces of the probe 10 and the apex 11 to help a smooth transmission of an electrical signal. The circuit board 30 and the probes 10 are bonded to each other with wires 13 and thus the coating layer of the probes 10 and terminals 31 of the circuit board30 are circuitally connected to each other. The terminals 31 formed on the circuit board 30 and connecting terminals 31 passing through the circuit board 30 are interconnected with each other with circuit threads 33. The connecting terminals 32 of the circuit board 30 and terminals 41 of the main circuit board 40 are interconnected with each other through a pad 50.

Metal threads 51 formed on the pad 50 serve to connect the terminals 41

formed on the main circuit board 40 to the connecting terminals 32 of the circuit board 30. Since an interval between the metal threads is narrower than an interval between the connecting terminals 32 or between the terminals 41, the numerous metal threads 51 connect the connecting terminals 32 and the terminals 41 into a bundle shape, in a state that the connecting terminals 32 and the terminals 41 are corresponding to each other in a one-to-one relation. One connecting terminal 32 and a terminal 41 are interconnected by the plurality of metal threads, so that an electrical signal of the connecting terminal 32 is transferred to the terminal 41. There are some metal threads between the connecting terminals 32 and between the terminals 41 but not connected to any terminals. These metal threads 51 do not transfer an electrical signal. A reference numeral 69, not explained, represents an insulating paper for performing an insulation function between the frame 60 and the main circuit board 40.

The completed probe card is mounted on the probe station and connected to a fog pin, and the subject 70 of measurement is disposed on a work shelf. The subject of measurement, namely the semiconductor wafer, and the probe card are adjusted vertically and horizontally, whereby the apex 11 of the pertinent probe 10 is elastically connected to a contact point 71 of the subject 70. Various electrical signals of the probe station are transferred to the semiconductor wafer, thereby checking the characteristics of the wafer.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

Industrial Applicability

As stated above, the present invention has an advantage of exactly measuring electrical characteristics of a plurality of semiconductor devices at the same time, since fine probes, whose height is very uniform and whose arrangement is very finely formed, are installable on an insulator board.

The present invention has another advantage of manufacturing a probe card having excellent electrical characteristics, since length of the probes are short and size of the probes is uniform.

The present invention has further another advantage of manufacturing a probe card having high elasticity, force of restoration and plastic deformation resistance, since the probe card is made of a single crystal silicone material.

The finely arranged probes are bonded to a circuit board with wires, and then the circuit board and a main circuit board are circuitally connected to each other with a pad on which a plurality of fine metal threads are implanted. The pad is positioned between terminals of the circuit board and terminals of the main circuit board. Therefore, the present invention has yet another advantage of enhancing productivity of the probe card, since the terminals of the circuit board and the main circuit board are circuitally connected, respectively, even though a position of the pad is not exactly adjusted.

What Is Claimed Is:

1. A probe card, comprising:

an insulator board on which a plurality of probes contacting with a subject of measurement are formed through an etching process;

a circuit board attached to the insulator board and having terminals, which are connected to the probes in a one-to-one correspondence with wires;

a main circuit board connected to a probe station, which transfers a measurement signal to the subject of measurement;

a pad made of an insulating material, interposed between the circuit board and the main circuit board, and having a plurality of metal threads implanted therein, with the metal threads projecting from a lower surface of the circuit board and from an upper surface of the main circuit board to circuitally connect both the circuit boards.

2. The probe card of claim 1, wherein the insulator board is provided with a plurality of passageways passing through upper and lower surfaces thereof; wires correspondingly arranged and connected to the respective probes, and connected to the terminals of the circuit board in a one-to-one relation; the rest probes are arranged in one direction on each side of the passageways; and the wires connected to the probes lined up toward the passageways are connected to the terminals of the circuit board in the one-to-one correspondence through the passageways.

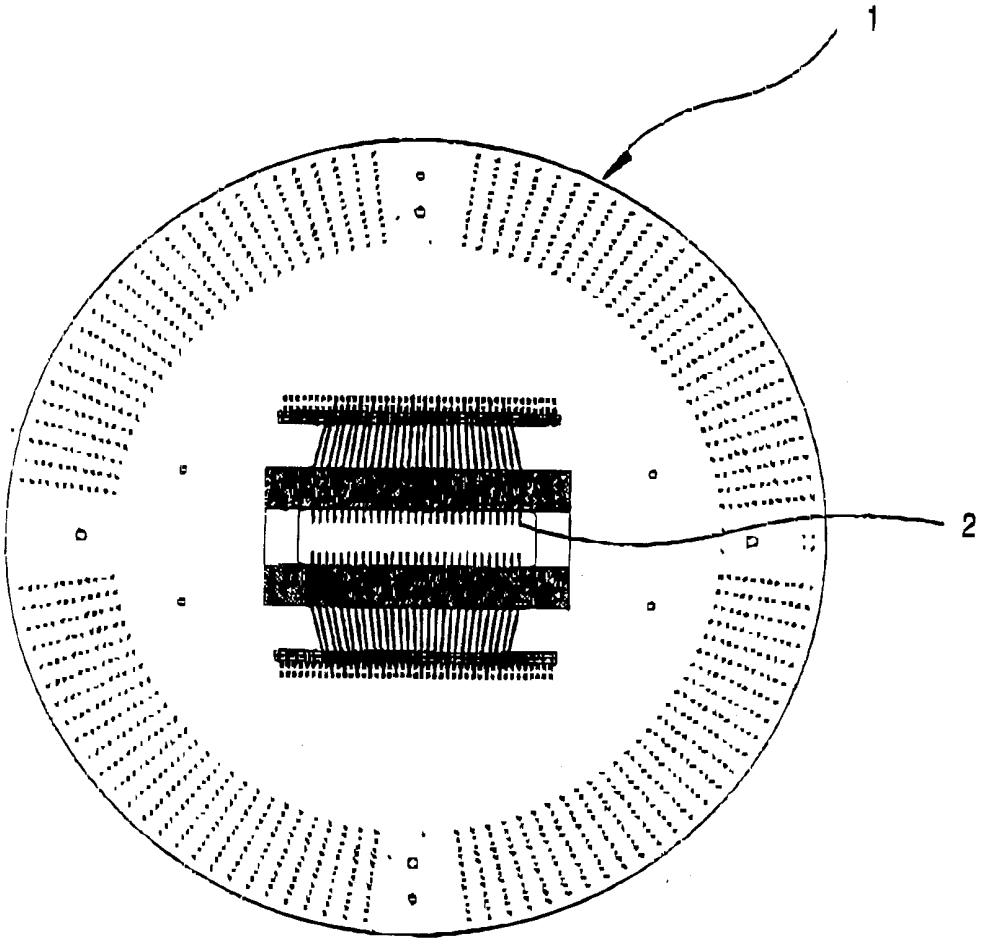
3. The probe card of claim 1, wherein the main circuit board is provided with a frame on an upper part thereof; passways are formed on a center of the frame for the upper surface of the main circuit board to be exposed; jaws are

formed on an upper part of the frame for the circuit board to be placed on an inner periphery of an upper end of the passways, and fixed to the circuit board with screws; and the pad is inserted into the passways between the main circuit board and the circuit board.

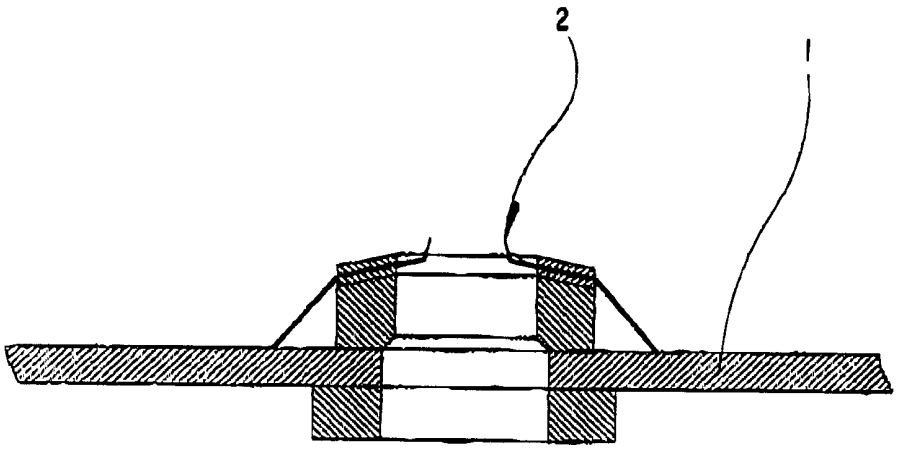
4. The probe card of claim 1, wherein the terminals of the circuit board are connected to the probes with the wires in the one-to-one correspondence; a plurality of connecting terminals passing through upper and lower ends of the circuit board are connected to the terminals of the circuit board with circuit threads in a one-to-one correspondence; a plurality of terminals formed on the upper surface of the main circuit board are circuitally connected to the connecting terminals of the circuit board through metal threads of the pad; and the terminals of the main circuit board are connected to the probe station through other circuit threads.

5. The probe card of claim 4, wherein the pad is made of a silicone rubber material; a diameter of the respective metal threads is less than 35 micro meter, and an interval between the respective metal threads in a vertical direction is 0.07 to 0.15mm while an interval between the respective metal threads in a horizontal direction is 0.4mm; and the metal threads connect the connecting terminals of the circuit board with the terminals of the main circuit board in a metal thread bundle shape.

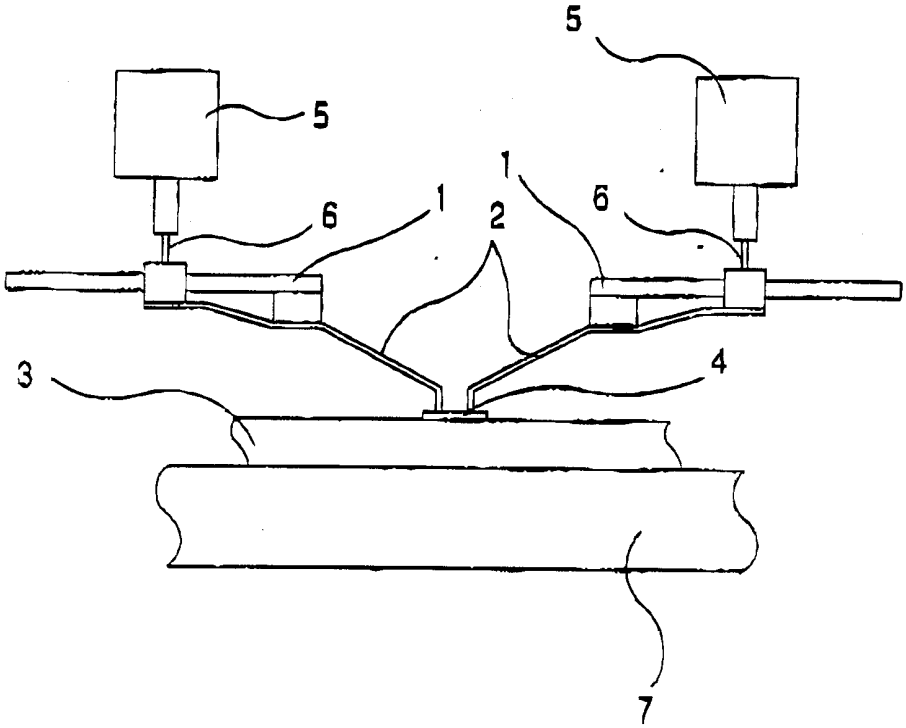
【Fig.1】



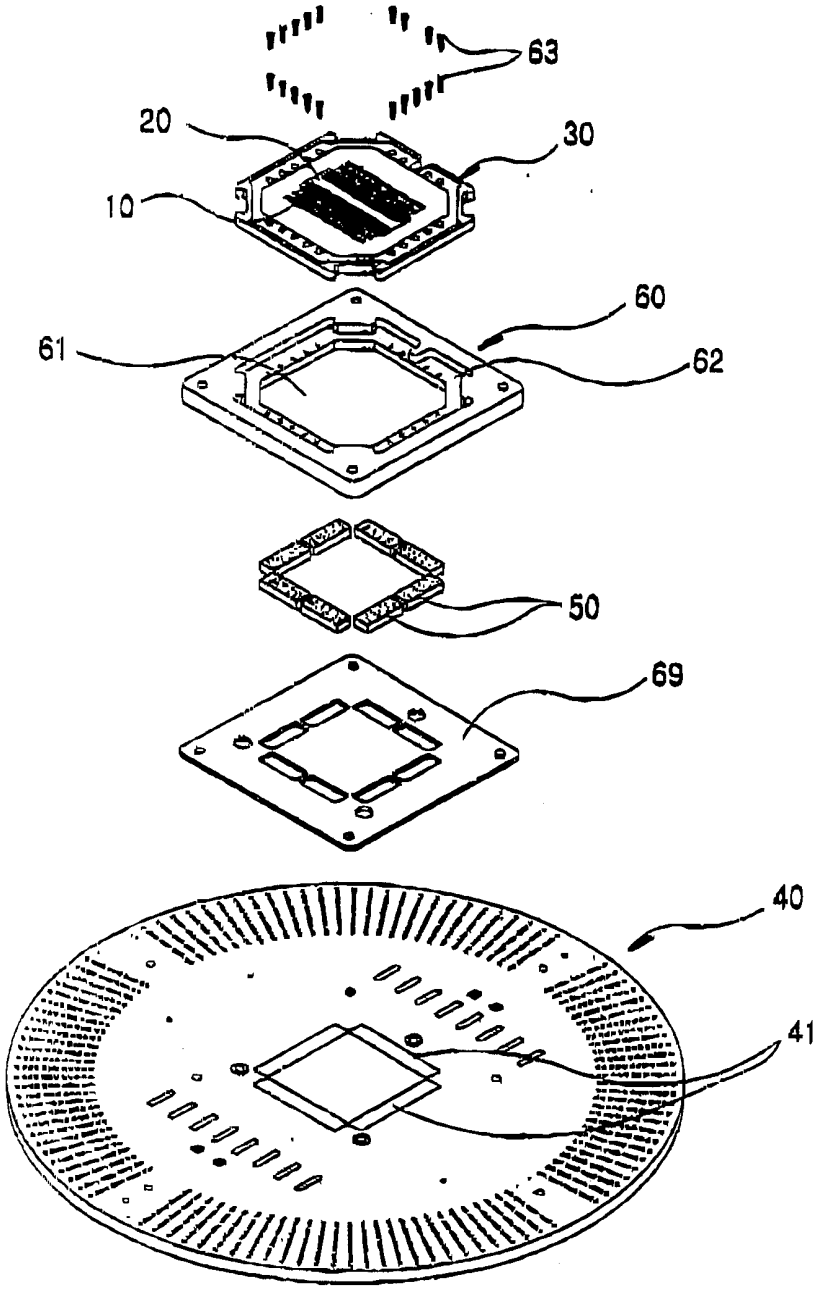
【Fig.2】



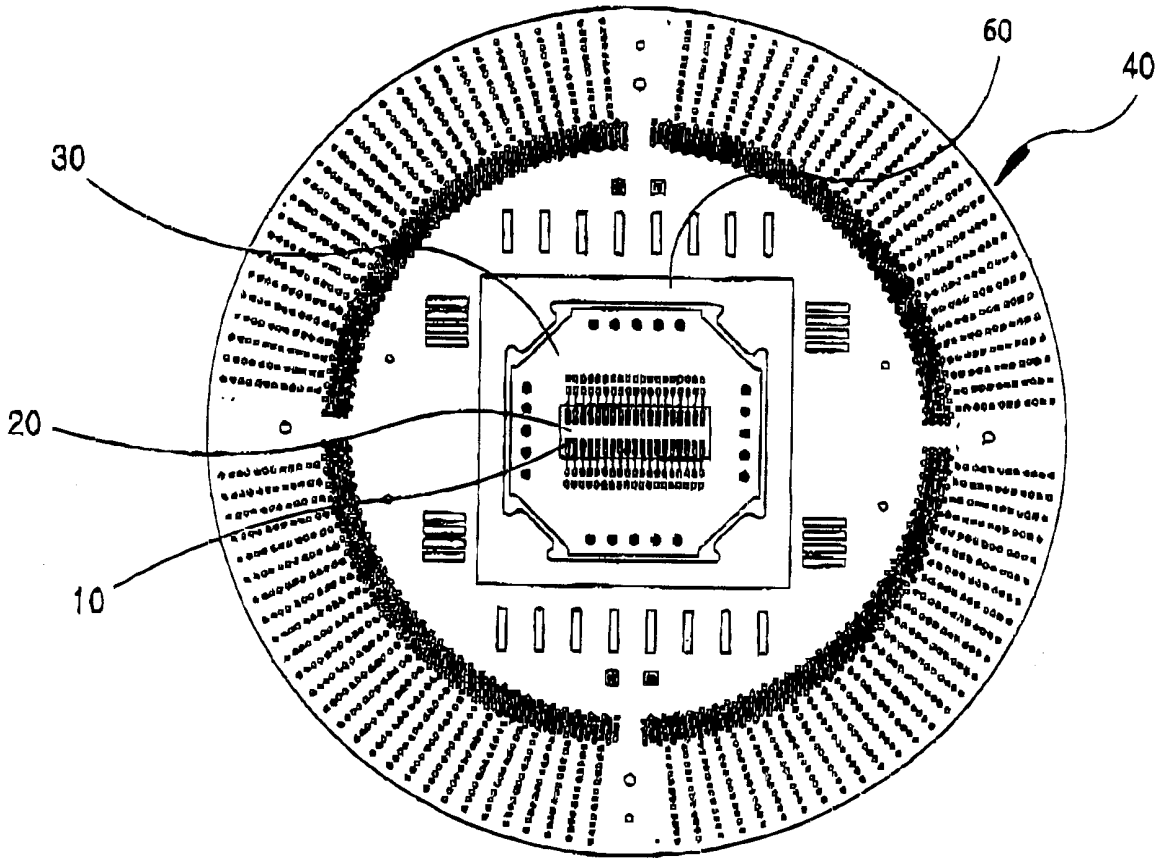
【Fig.3】



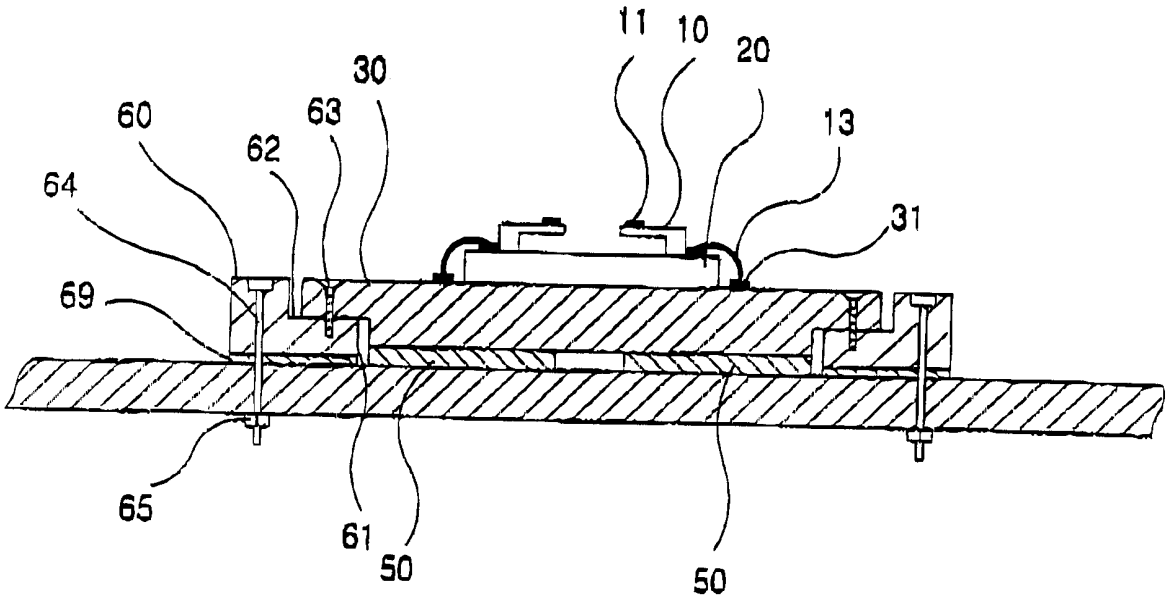
【Fig.4】



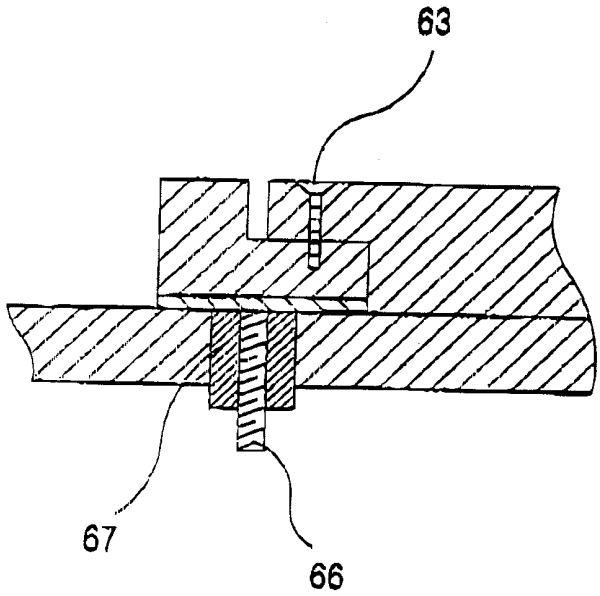
【Fig.5】



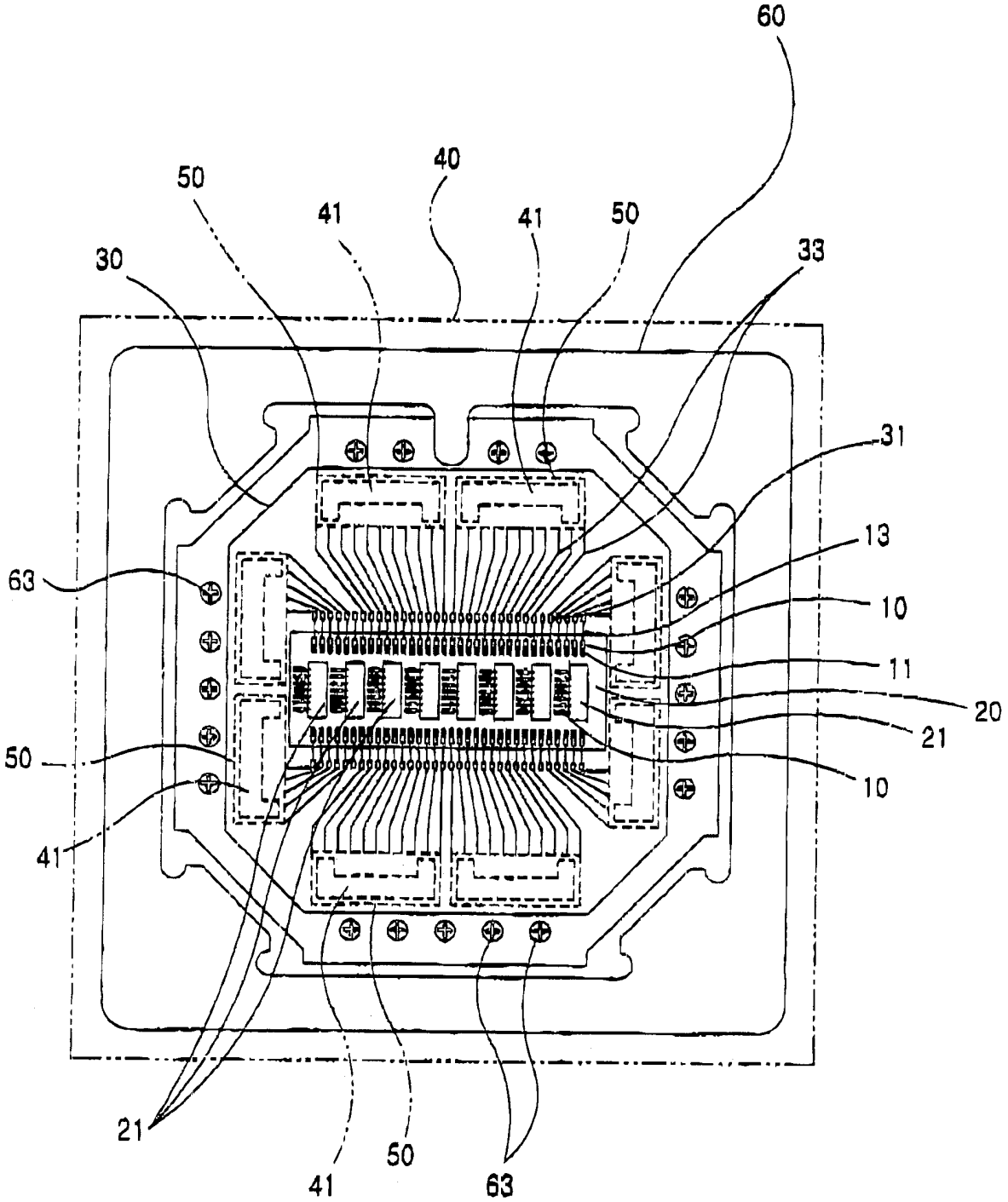
【Fig.6a】



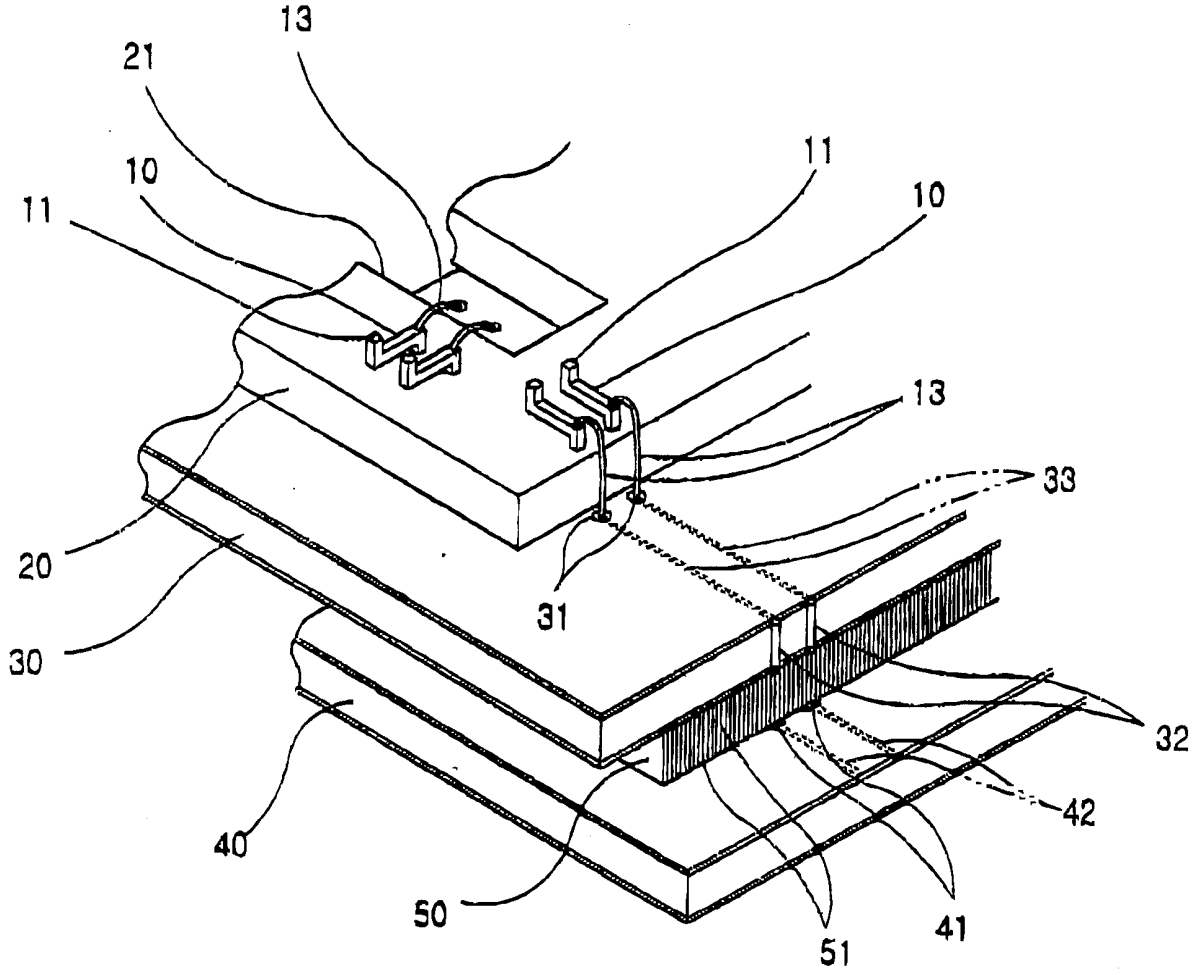
【Fig.6b】



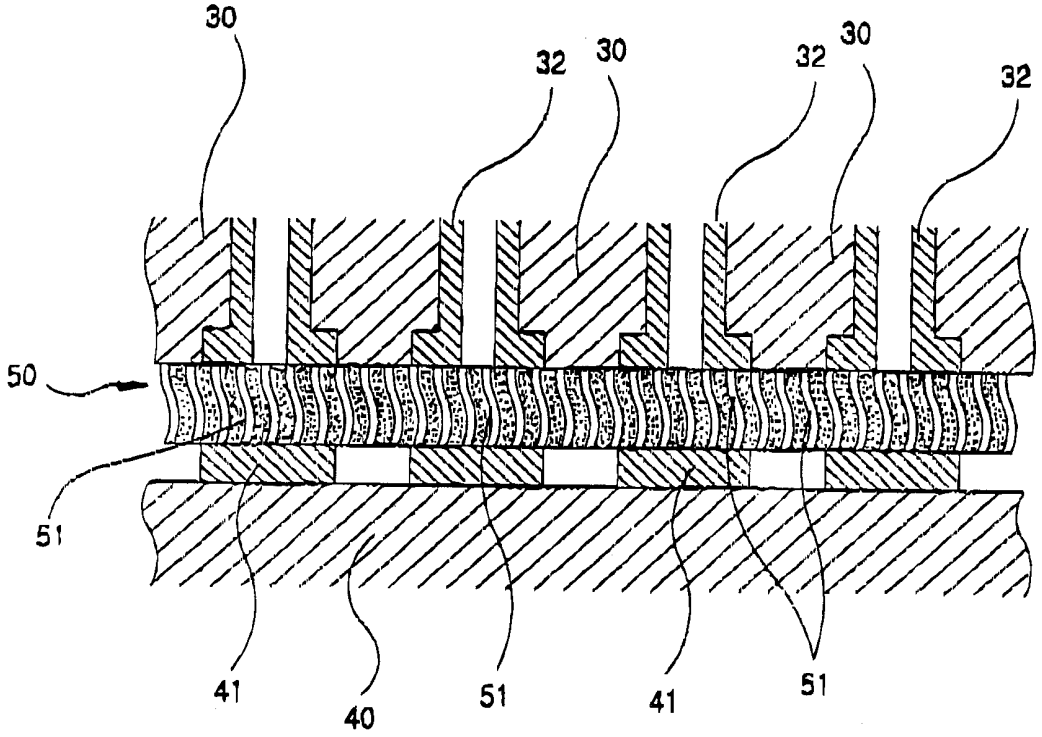
【Fig.7】



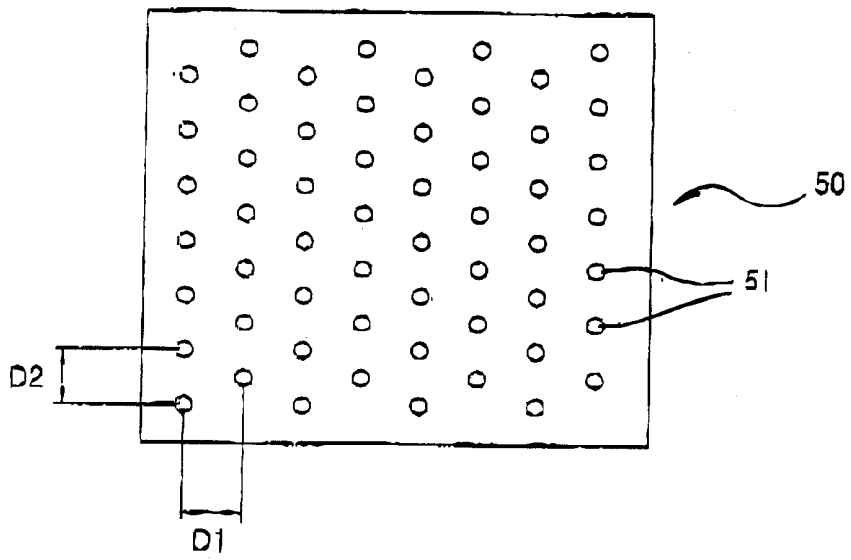
【Fig.8】



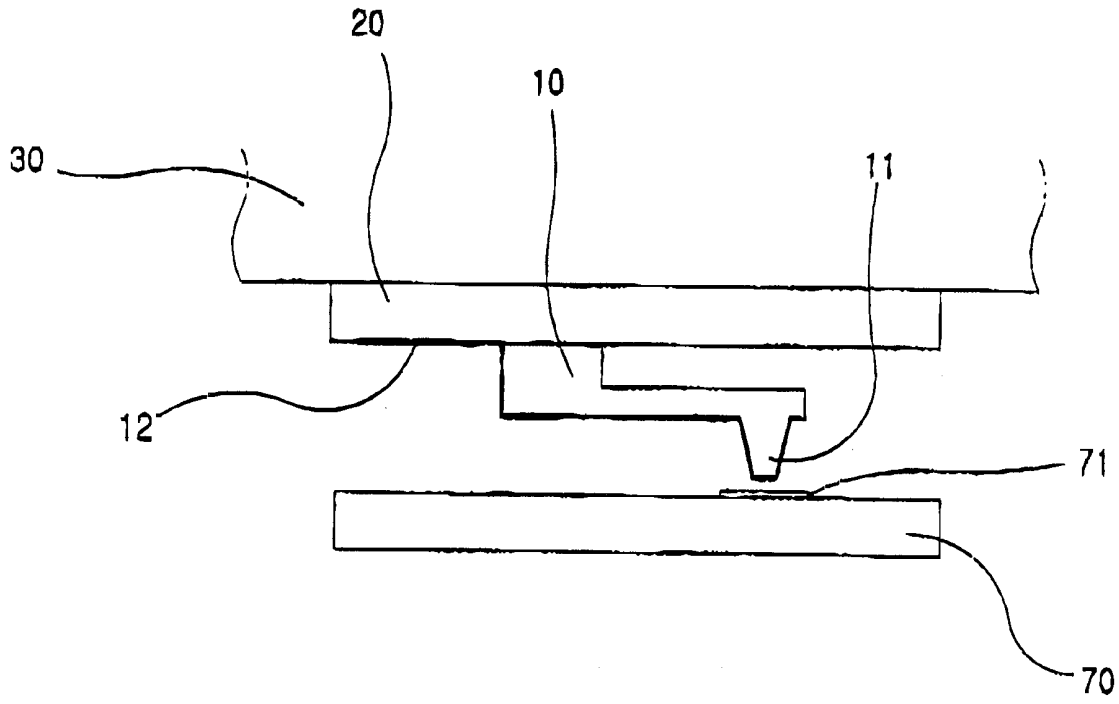
【Fig.9a】



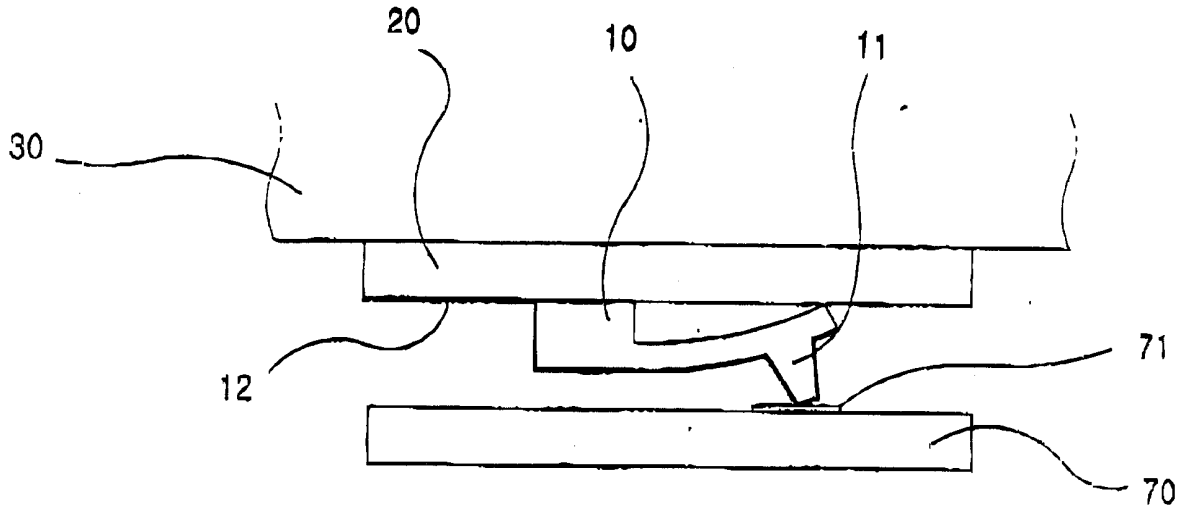
【Fig.9b】



【Fig.10a】



【Fig.10b】



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR00/00086

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G01R 1/073, H01L 21/66

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimun documentation searched (classification system followed by classification symbols)

IPC7 G01R 1/073, H01L 21/66

Documentation searched other than minimun documentation to the extent that such documents are included in the fileds searched

Korean Patent and application for invention since 1975
Korean Utility models and applications for Utility models since 1975

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search trerms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Patent Abstract of Japan, JP 06-174747 A (NIPPON TELEGR & TELEPH CO., NTT) 24 JUNE 1994	1
A	Patent Abstract of Japan, JP 09-15262 A (NEC KANSAI LTD.) 17 January 1997	1
A	US 5,559,446 A (TOKYO ELECTRON KABUSHIKI KAISHA) 24 September 1996	1
A	US 5,982,183 A ((TOKYO ELECTRON KABUSHIKI KAISHA) 09 October 1999	1
A	KR 95-21433 U (LG ElECTRONIC CO.) 28 JULY 1995	1
A	KR 95-21436 U (LG ELECTRONIC CO.) 28 JULY 1995	1

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 MAY 2000 (17.05.2000)	18 MAY 2000 (18.05.2000)

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