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Nakamura et al.

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(54) **KELVIN CONTACT PROBE STRUCTURE AND A KELVIN INSPECTION FIXTURE PROVIDED WITH THE SAME**

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G01R 1/067	(2006.01)
G01R 31/28	(2006.01)

(52) **U.S. Cl.**
CPC ***G01R 1/073*** (2013.01); ***G01R 1/06722*** (2013.01); ***G01R 31/2884*** (2013.01); ***G01R 31/2886*** (2013.01); *G01R 1/06738* (2013.01)

(58) **Field of Classification Search**
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USPC 324/754.05, 754.03
See application file for complete search history.

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(57) **ABSTRACT**

A Kelvin inspection fixture is provided with contact probes, wherein the contact probe comprises an electrode side contact terminal in contact with a solder ball, and a land side contact terminal in contact with a land, and the contact probe comprises an electrode side contact terminal in contact with the solder ball, and a land side contact terminal in contact with a land. The contact probes are disposed so that an electrode side inclined face and an electrode side inclined face are held in an opposite relationship with respect to each other and so that a land side inclined face and a land side inclined face are held in a face to face relationship with respect to each other.

5 Claims, 10 Drawing Sheets

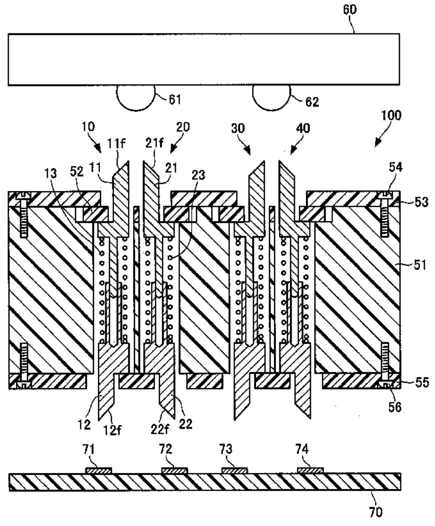

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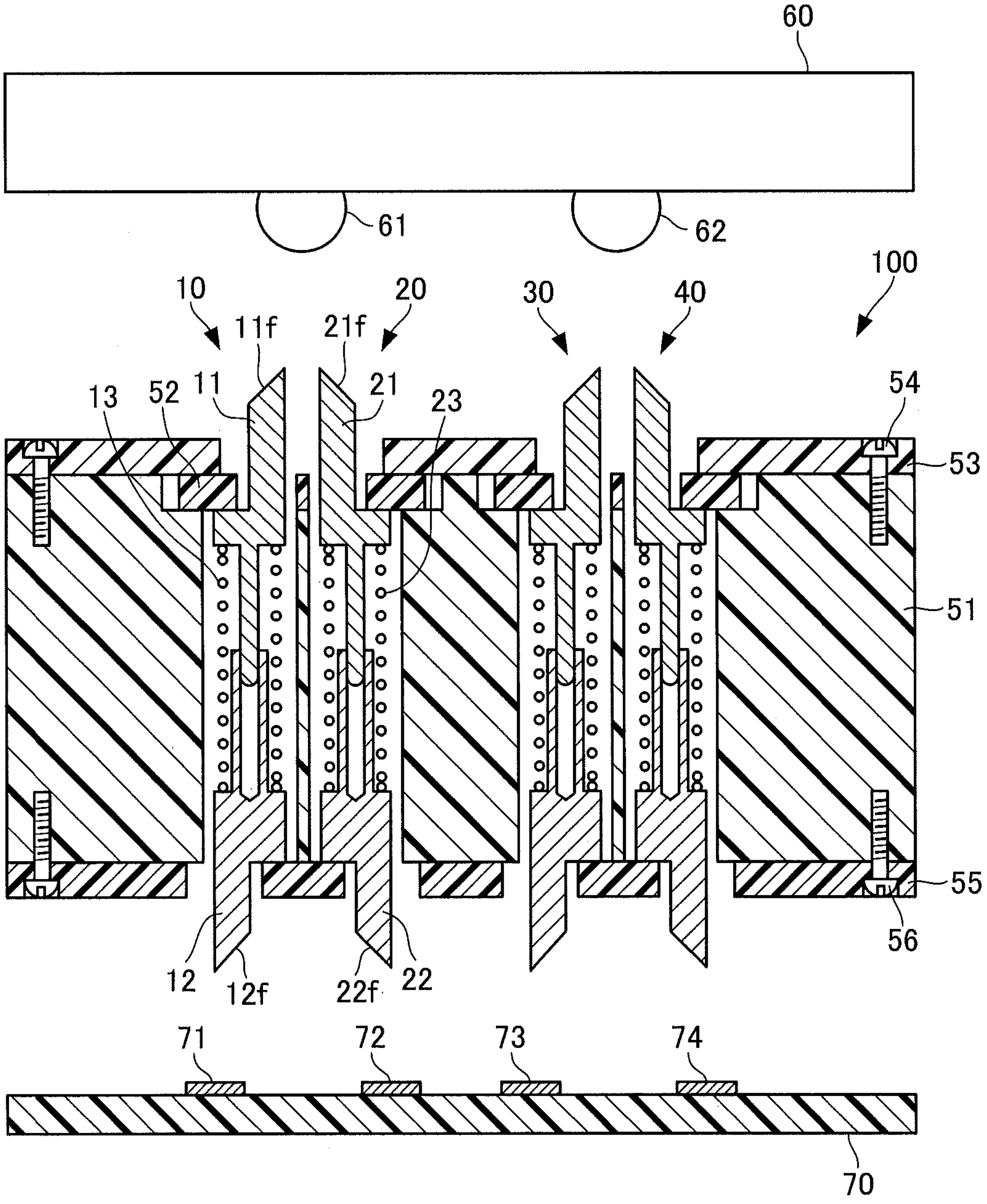
FIG.1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61
62
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10
20
30
40
11f
21f
11
21
13
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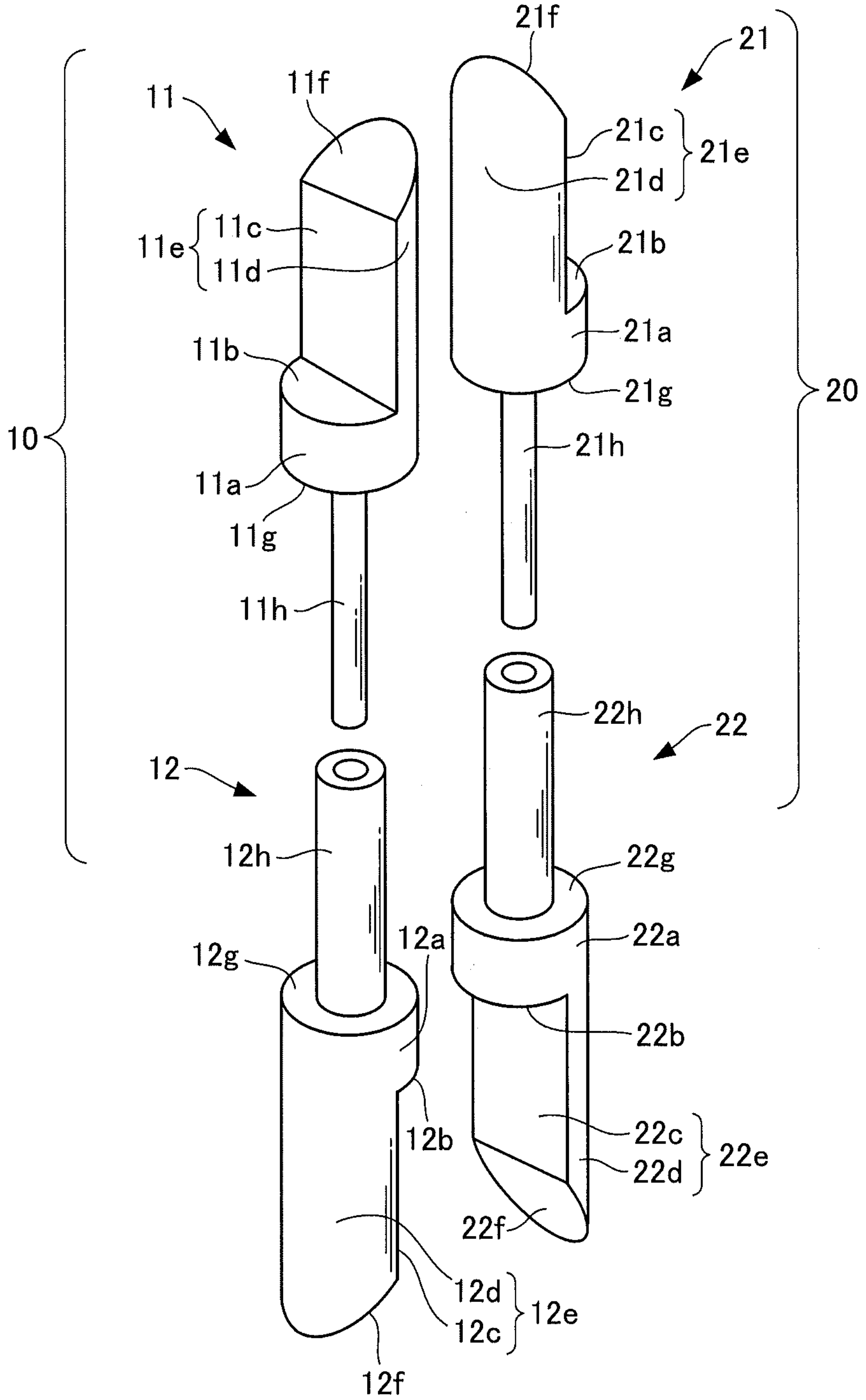
56
12
12f
22f
22
71
72
73
74
70

FIG.2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21c
21e
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11c
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21b
21a
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10
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11a
11g
11h
22h
22
12
12h
22g
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12a
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FIG.3A

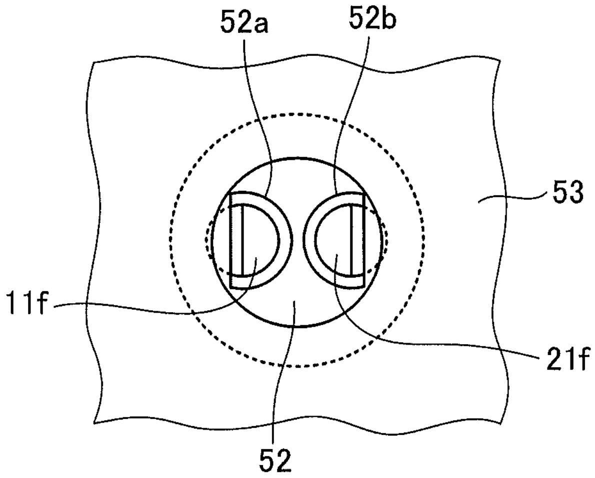


FIG.3B

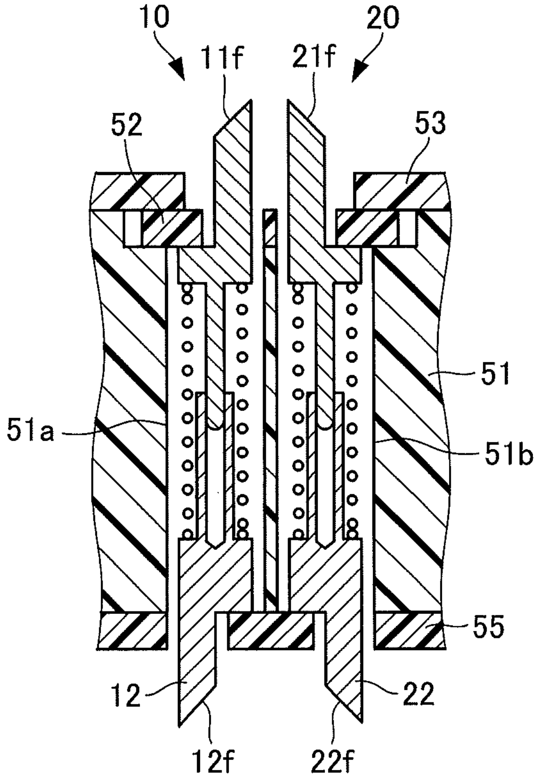


FIG.3C

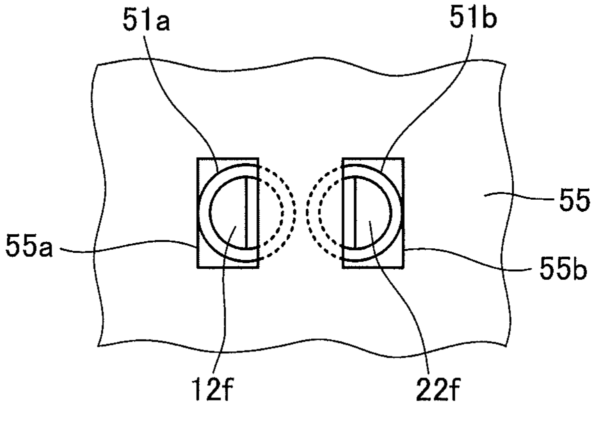


FIG.4

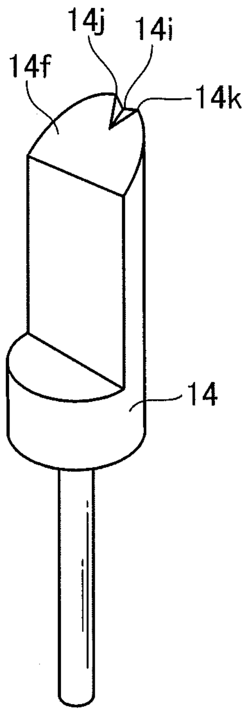


FIG.5A

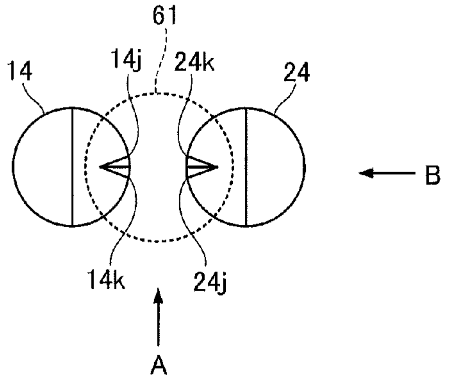
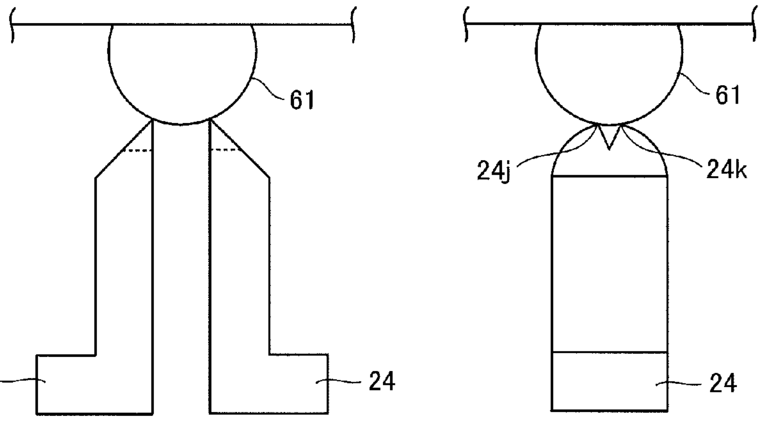


FIG.5B



A ARROW VIEW

B ARROW VIEW

FIG.6A

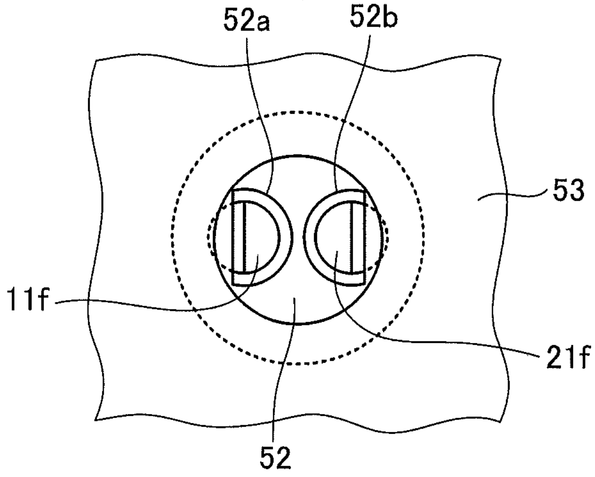


FIG.6B

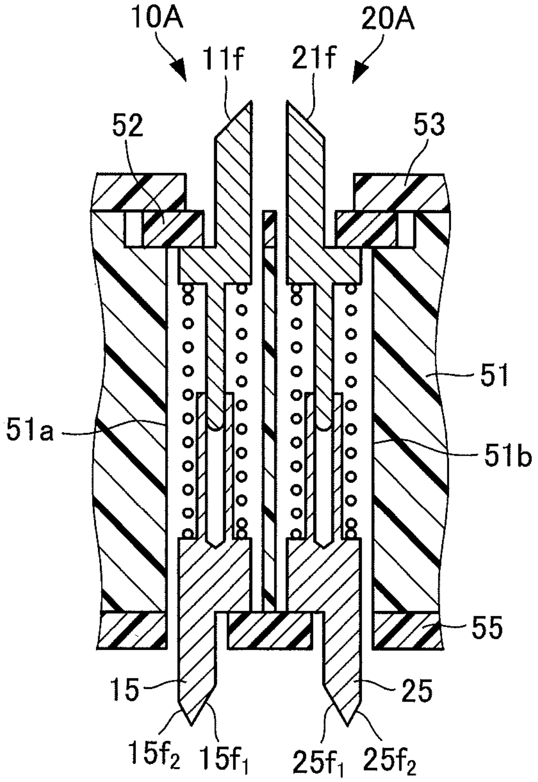


FIG.6C

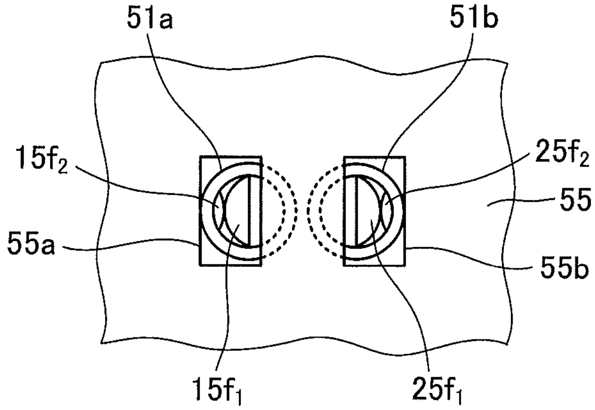


FIG.7A

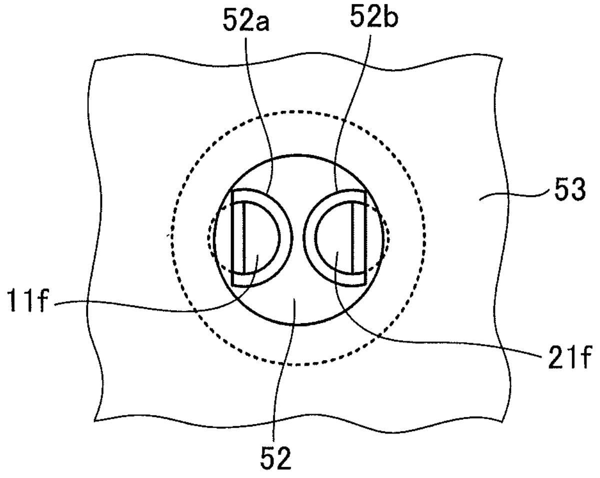


FIG.7B

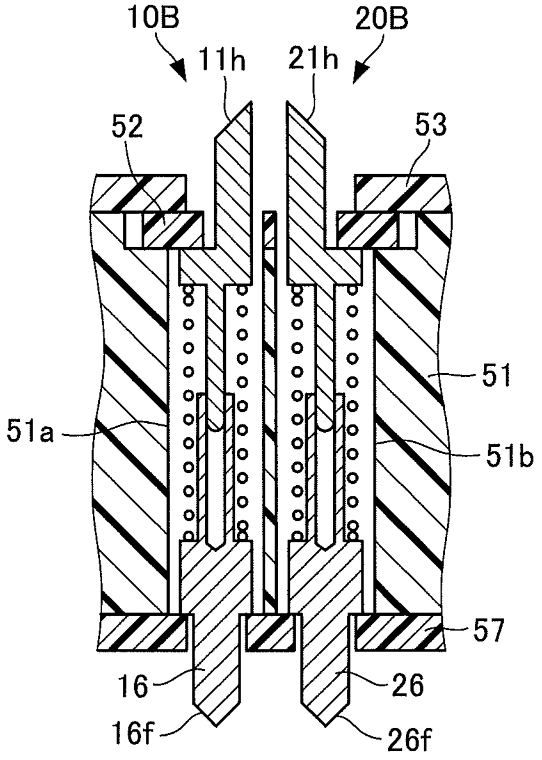


FIG.7C

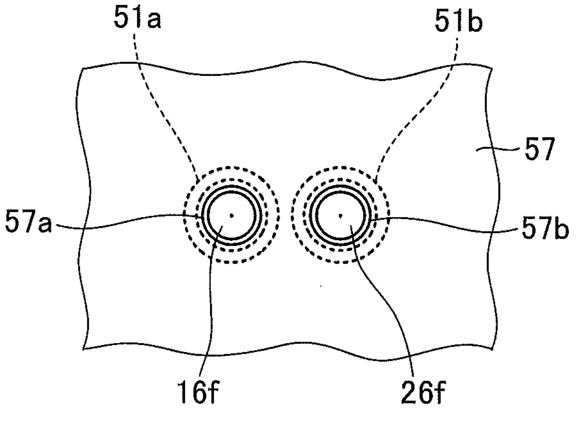


FIG.8A

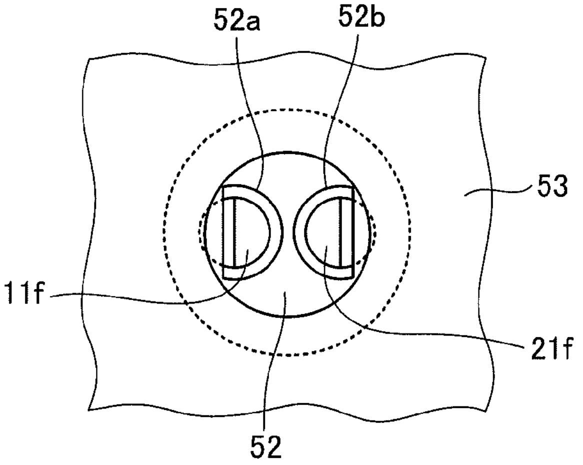


FIG.8B

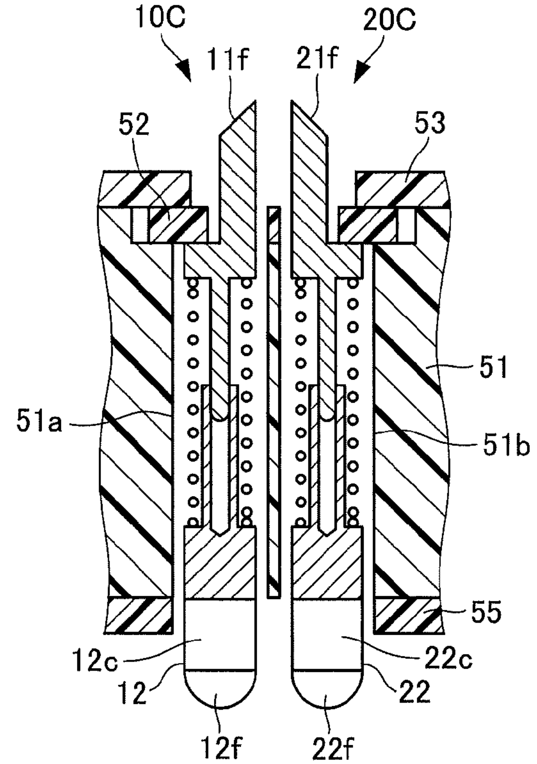


FIG.8C

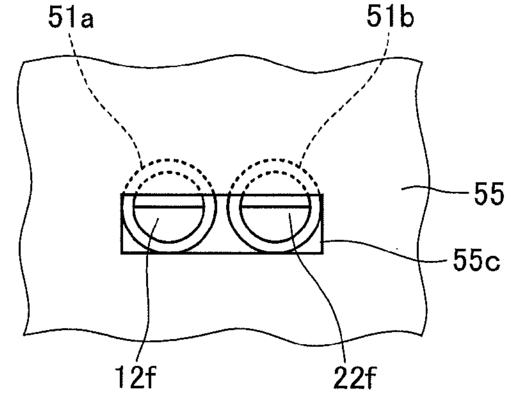


FIG.9A

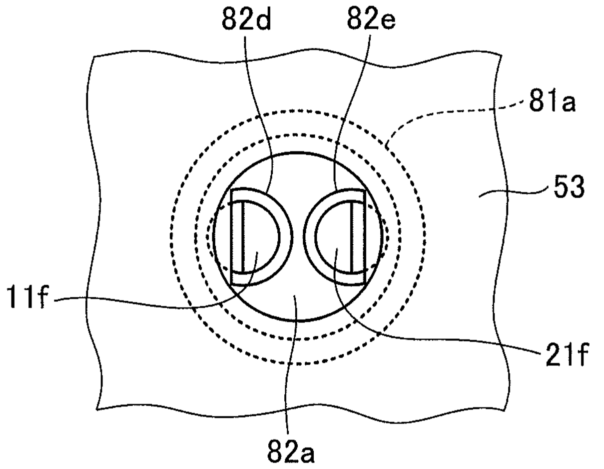


FIG.9B

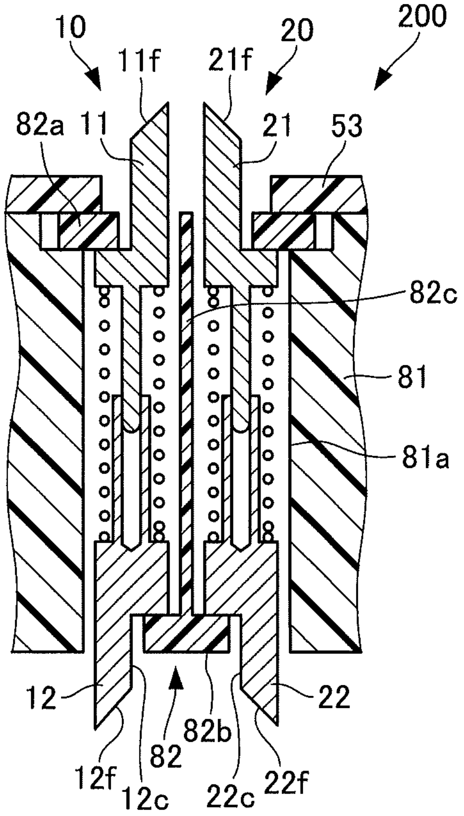


FIG.9C

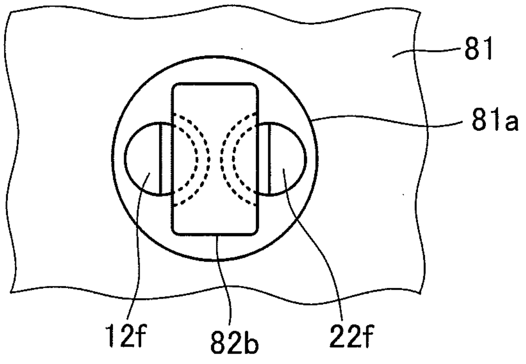


FIG.10A

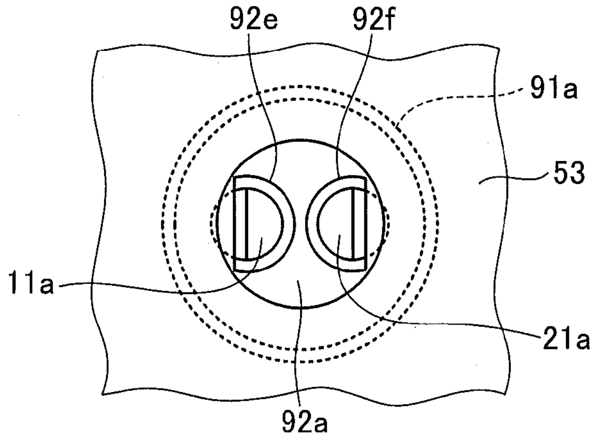


FIG.10B

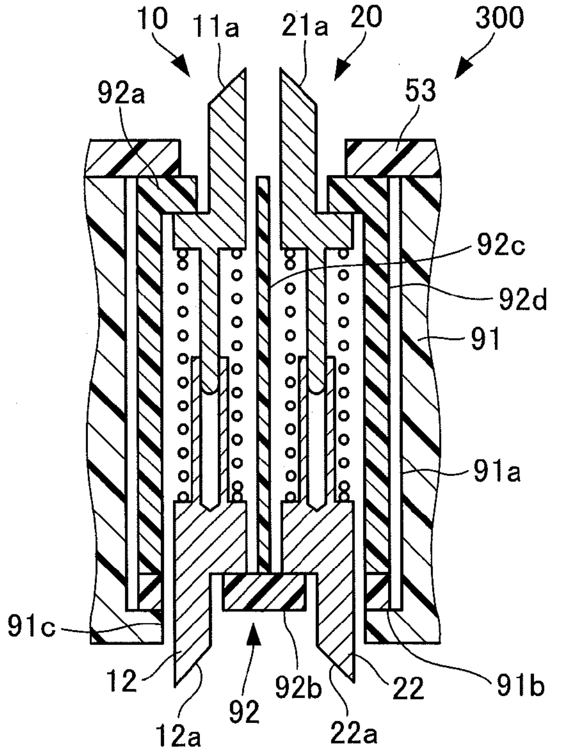
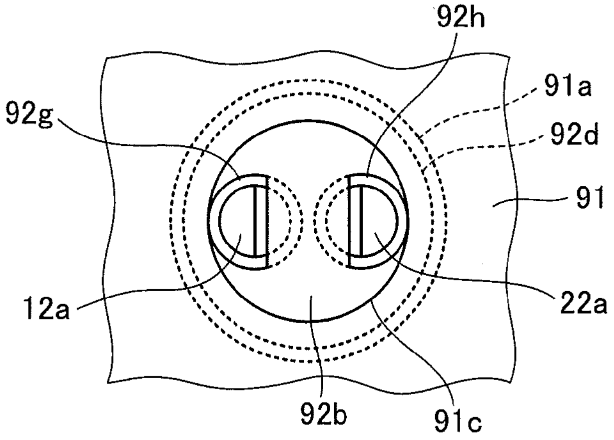


FIG.10C



KELVIN CONTACT PROBE STRUCTURE AND A KELVIN INSPECTION FIXTURE PROVIDED WITH THE SAME

TECHNICAL FIELD

The present invention relates to a Kelvin contact probe structure equipped with at least two contact probes, and, more particularly, to a Kelvin contact probe to be used during the inspection of a semiconductor integrated circuit, and a Kelvin inspection fixture equipped with the Kelvin contact probe structure.

BACKGROUND ART

Conventionally, as a method for the measurement of a two-terminal circuit is known a Kelvin connection measurement method (four-terminal resistance measurement method) is known. In the measurement method by Kelvin connection, each terminal of the two-terminal circuit is connected with probes respectively constituting parts of an electric current supply circuit and a voltage measurement circuit, thereby making it possible to inspect the two-terminal circuit without being affected by any circuit resistance of the electric current supply circuit and the voltage measurement circuit, as well as any contact resistance between the probes and the terminals.

As one of Kelvin inspection fixtures to be operated through the measurement method by Kelvin connection to inspect semiconductor integrated circuits and semiconductor devices (hereinafter simply referred to as "IC and others"), there have been proposed such as, for example, those disclosed in Patent Document 1. The Kelvin inspection fixture thus disclosed has two contact probes which are arranged in parallel with each other. Each of the contact probes includes an electrode side top end portion contactable with one of solder ball electrodes each forming part of the IC, and a land side top end portion contactable with one of lands respectively formed on a circuit substrate to be connected with an inspection circuit. Each of the electrode side top end portions has two inclined surfaces inclined in different angles with respect to the axial direction of the contact probe, and ridge lines formed with the two inclined surfaces and arranged to face each other.

The conventional Kelvin inspection fixture as disclosed in the above is configured to have the ridge lines of the electrode side top end portions wedged into the solder ball electrode while being securely engaged with the solder ball electrode, thereby causing oxides on the surface of the solder ball electrode to be broken, and thereby ensuring that the contact robe can electrically be connected with the solder ball electrode.

CITATION LIST

Patent Literature

Patent Document 1: Japanese Patent Publication No. 2008-96368

SUMMARY OF INVENTION

Technical Problem

In the IC and others, the solder ball electrodes or planar electrodes have recently been reduced in pitch in response to the miniaturization of integrated circuits, thereby achieving

the minimization in size of the electrode itself. Under these circumstances, the Kelvin inspection fixture encounters such a problem as below.

(1) The conventional Kelvin inspection fixture is constituted by electrode side top end portions respectively having ridge lines arranged in face-to-face relationship with each other, so that the Kelvin inspection fixture can respond to the reduced pitch to a certain degree for the electrode of the IC and others in the form of a solder ball, but is difficult to respond the reduced pitch for the electrode of the IC and others in the form of a planar shape.

(2) The conventional Kelvin inspection fixture is constituted with land side top end portions having a pitch which is automatically determined by the pitch of the two contact probes, and therefore encounters such a problem that there is a case in which the lands of the circuit substrate and the wiring patterns become reduced in pitch in order to meet the need of the reduced pitch of the electrodes, thereby making it impossible to produce the inspection fixture, or otherwise there is a case in which the production cost of the circuit substrate is increased even if the inspection fixture can be produced.

The present invention has been made in order to solve the problems of the prior art, and has therefore an object to provide a Kelvin contact probe structure and a Kelvin inspection fixture provided with the Kelvin contact probe structure which can cope with narrow pitches of the electrode regardless of the shape of electrode to be inspected, and, moreover, can avoid an increase in manufacturing cost of the circuit substrate.

Solution to Problem

The Kelvin contact probe structure according to the present invention comprises: two contact probes including one contact probe and the other contact probe, and axially arranged in parallel with each other to have one electrode electrically connected with two lands, and the electrode being provided on an inspection object to be inspected, and the two lands being provided on a circuit substrate, which is so constructed that each of the one contact probe and the other contact probe has an electrode side contact terminal and a land side contact terminal provided therein, the electrode side contact terminal arranged in an electrode side to be contactable with the electrode, the land side contact terminal being arranged in a land side to be contactable with the land, each of the one contact probe and the other contact probe includes the electrode side contact terminal contactable with the electrode, the land side contact terminal contactable with the land and a metal spring arranged between the electrode side contact terminal and the land side contact terminal, the electrode side contact terminal includes a disk shaped electrode side contact terminal flange portion, an electrode side contact terminal rotation preventing portion, an electrode side inclined surface portion and a cylindrical rod, the disk shaped electrode side contact terminal flange portion having an electrode side surface and a land side surface, the electrode side contact terminal rotation preventing portion stretching from the electrode side surface of the electrode side contact terminal flange portion to be defined by a plate shaped electrode side contact terminal rotation preventing surface and a semi arc shaped electrode side contact terminal semi arc surface, the electrode side inclined surface portion defined by a surface inclined from center of a top end of the electrode side contact terminal semi arc surface toward the electrode side contact terminal flange portion, the cylindrical rod stretching from center of the land side surface of the electrode side contact terminal flange portion and being smaller in diameter than the electrode side contact terminal flange portion, the land side contact terminal includes a disk shaped land side contact terminal flange portion, a land side contact terminal rotation preventing portion, a land side inclined surface portion and a cylindrical hollow rod, the disk shaped land side contact terminal flange portion having a land side surface and an electrode side surface, the land side contact terminal rotation preventing portion stretching from the land side surface of the land side contact terminal flange portion to be defined by a plate shaped land side contact terminal rotation preventing surface and a semi arc shaped land side contact terminal semi arc surface, the land side inclined surface portion defined by a surface inclined from center of a top end of the land side contact terminal semi arc surface toward the land side contact terminal flange portion, the cylindrical hollow rod stretching from center of the electrode side surface of the land side contact terminal flange portion and being smaller in diameter than the land side contact terminal flange portion to receive the cylindrical rod, the metal spring being arranged between the land side surface of the electrode side contact terminal flange portion and the electrode side surface of the land side contact terminal flange portion, and the one contact probe and the other contact probe being arranged in such a manner that the electrode side inclined surfaces faces are held in an opposite relationship with respect to each other and that the land side inclined surfaces are held in a face to face relationship with respect to each other.

By the construction as set forth above, the Kelvin contact probe structure according to the present invention is so constructed that the one contact probe and the other contact probe are arranged in such a manner that each of the electrode side inclined surfaces are held in the opposite relationship with respect to each other and that each of the land side inclines surfaces are held in the face to face relationship with each other, thereby making it possible to cope with narrow pitches of the electrode regardless of the shape of electrode of the inspection object to be inspected, and, moreover, to avoid an increase in manufacturing cost of the circuit substrate.

Further, the Kelvin contact probe structure according to the present invention is so constructed that each of the electrode side contact terminals has a plurality of apices formed by at least one groove arranged at a top portion of the electrode side inclined surface.

By the construction as set forth above, the Kelvin contact probe structure according to the present invention can bring a plurality of apices into contact with the electrode of the inspection object to be inspected, thereby making it possible to obtain a more stable contact state.

The Kelvin inspection fixture according to the present invention comprises the Kelvin contact probe structure which comprises a housing body provided therein with a through bore and adapted to retain the one contact probe and the other contact probe through the through bore; an electrode side retention body that retains the electrode side contact terminal; and a land side retention body that retains the land side contact terminal.

By the construction as set forth above, the Kelvin contact probe structure according to the present invention can cope with narrow pitches of the electrode regardless of the shape of electrode of the inspection object to be inspected, and, moreover, can avoid an increase in manufacturing cost of the circuit substrate.

The Kelvin inspection fixture according to the present invention may preferably be so constructed to be provided with a connection portion arranged between the one contact probe and the other contact probe and adapted to connect the electrode side retention body and the land side retention body.

The Kelvin inspection fixture according to the present invention may preferably be so constructed to be provided with a cover member that covers an outer periphery of the one contact probe and the other contact probe.

Advantageous Effect of Invention

The present invention can provide a Kelvin contact probe structure and a Kelvin inspection fixture provided with the Kelvin contact probe structure which can cope with narrow pitches of the electrode regardless of the shape of electrode of the inspection object to be inspected, and, moreover, can avoid an increase in manufacturing cost of the circuit substrate.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a cross-sectional view showing the construction of a first embodiment of a Kevin inspection fixture according to the present invention.

FIG. **2** is a perspective view showing a contact probe forming part of the first embodiment of the Kevin inspection fixture according to the present invention.

FIGS. **3**A, **3**B and **3**C are construction views showing the peripheral portion of the contact probe forming part of the first embodiment of the Kevin inspection fixture according to the present invention.

FIG. **4** is a perspective view similar to FIG. **1** but showing another embodiment 1 of the contact probe forming part of the first embodiment of the Kevin inspection fixture according to the present invention.

FIGS. **5**A and **5**B respectively show the construction of another embodiment 1 of the contact probe forming part of the first embodiment of the Kevin inspection fixture according to the present invention.

FIGS. **6**A, **6**B and **6**C are construction views respectively similar to FIGS. **3**A, **3**B and **3**C but showing the peripheral portion of another embodiment 2 of the contact probe forming part of the Kevin inspection fixture according to the present invention.

FIGS. **7**A, **7**B and **7**C are construction views respectively similar to FIGS. **3**A, **3**B and **3**C but showing the peripheral portion of another embodiment 3 of the contact probe forming part of the Kevin inspection fixture according to the present invention.

FIGS. **8**A, **8**B and **8**C are construction views respectively similar to FIGS. **3**A, **3**B and **3**C but showing the peripheral portion of another embodiment 4 of the contact probe forming part of the Kevin inspection fixture according to the present invention.

FIGS. **9**A, **9**B and **9**C are construction views respectively similar to FIGS. **3**A, **3**B and **3**C but showing the peripheral portion of a second embodiment of the Kevin inspection fixture according to the present invention.

FIGS. **10**A, **10**B and **10**C are construction views respectively similar to FIGS. **3**A, **3**B and **3**C but showing the peripheral portion of a third embodiment of the Kevin inspection fixture according to the present invention.

DESCRIPTION OF EMBODIMENTS

Hereinafter, embodiments of the present invention will be explained with reference to drawings.

First Embodiment

As shown in FIG. **1**, a Kelvin inspection fixture **100** according to the present embodiment is adapted to inspect a resistance between a solder ball **61** and a solder ball **62** respectively arranged on a lower surface of an IC **60** by a Kelvin connection, the IC **60** being an integrated circuit of BGA (Ball Grid Array) type as an inspection object to be inspected. In a lower surface side of the Kelvin inspection fixture **100** is provided a circuit substrate **70** to which wirings (not shown) are connected from a current supply circuit or a voltage measurement circuit. The circuit substrate **70** has lands **71**-**74** provided on an upper surface thereof.

The Kelvin inspection fixture **100** has arranged therein with contact probes **10**, **20**, **30** and **40**, a housing body **51**, an electrode side retention body **52**, a pressing plate **53**, a screw **54**, a land side retention body **55** and a screw **56**.

The Kelvin inspection fixture **100** is so constructed that the contact probes **10** and **20** are brought into contact with the solder ball **61** while the contact probes **30** and **40** are brought into contact with the solder ball **62**. As shown in drawings, although each of the contact probes **20**, **30** and **40** has the same elements as those of the contact probe **10**, each of the contact probes **20**, **30** and **40** is assigned numerals different from those of the contact probe **10**, for convenience of explanation. A set of contact probes **10** and **20** and a set of contact probes **30** and **40** respectively constitute a Kelvin contact probe structure according to the present invention.

The contact probe **10** has provided therein with a metal electrode side contact terminal **11** contactable with the solder ball **61**, a metal land side contact terminal **12** contactable with the land **71** and a metal spring **13** arranged between the electrode side contact terminal **11** and the land side contact terminal **12**.

Similarly, the contact probe **20** has provided therein with a metal electrode side contact terminal **21** contactable with the solder ball **61**, a metal land side contact terminal **22** contactable with the land **72** and a metal spring **23** arranged between the electrode side contact terminal **21** and the land side contact terminal **22**.

Next, the construction of the contact probes **10** and **20** is explained in detail with reference mainly to FIG. **2** and appropriately to FIG. **1**. In FIG. **2**, the spring **13** and the spring **23** are omitted for convenience of explanation.

As shown in FIG. **2**, the electrode side contact terminal **11** of the contact probe **10** includes a disk shaped electrode side contact terminal flange portion **11***a*, an electrode side contact terminal rotation preventing portion **11***e*, an electrode side inclined surface portion **11***f* and a cylindrical rod **11***h*, the disk shaped electrode side contact terminal flange portion **11***a* has an electrode side surface **11***b* and a land side surface **11***g*, the electrode side contact terminal rotation preventing portion **11***e* stretching from the electrode side surface **11***b* of the electrode side contact terminal flange portion **11***a* to be defined by a plate shaped electrode side contact terminal rotation preventing surface **11***c* and a semi arc shaped electrode side contact terminal semi arc surface **11***d*, the electrode side inclined surface portion **11***f* defined by a surface inclined from center of a top end of the electrode side contact terminal semi arc surface **11***d* toward the electrode side contact terminal flange portion **11***a*, the cylindrical rod **11***h* stretching from center of the land side surface **11***g* of the electrode side contact terminal flange portion **11***a* and being smaller in diameter than the electrode side contact terminal flange portion **11***a*.

On the other hand, the land side contact terminal **12** of the contact probe **10** includes a disk shaped land side contact terminal flange portion **12***a*, a land side contact terminal rotation preventing portion **12***e*, a land side inclined surface portion **12***f* and a cylindrical hollow rod **12***h*, the disk shaped land side contact terminal flange portion **12***a* has a land side surface **12***b* and an electrode side surface **12***g*, the land side contact terminal rotation preventing portion **22***e* stretching from the land side surface **22***b* of the land side contact terminal flange portion **22***a* to be defined by a plate shaped land side contact terminal rotation preventing surface **12***c* and a semi arc shaped land side contact terminal semi arc surface **12***d*, the land side inclined surface portion **11***f* defined by a surface inclined from center of a top end of the land side contact terminal semi arc surface **12***d* toward the land side contact terminal flange portion **12***a*, the cylindrical hollow rod **12***h* stretching from center of the electrode side surface **12***g* of the land side contact terminal flange portion **12***a* and being smaller in diameter than the land side contact terminal flange portion **12***a* to receive the cylindrical rod **11***h*.

In the present embodiment, the electrode side contact terminals **11** and **21**, the land side contact terminals **12** and **22** are formed by processing a metal cylindrical body, however, the electrode side contact terminals **11** and **21**, the land side contact terminals **12** and **22** may also be formed by processing a triangular prism body or a polygonal prism body.

The electrode side inclined surface **11***f* is defined by a surface inclined from center of a top end of the electrode side contact terminal semi arc surface **11***d* toward the electrode side contact terminal flange portion **11***a*, while the land side inclined surface **12***f* is defined by surface inclined from center of a top end of the land side contact terminal semi arc surface **12***d* toward the land side contact terminal flange portion **12***a*. In the present embodiment, each of the inclined surfaces forms an angle of approximately 45 degrees with respect to a center axis of the contact probe **10**. However, the angle is not limited to the above mentioned specific angle. Further, the electrode side inclined surface **11***f* and the land side inclined surface **12***f* are preferably arranged to be parallel with respect to each other.

The electrode side surface **11***b* of the electrode side contact terminal flange portion **11***a* and the land side surface **12***b* of the land side contact terminal flange portion **12***a* are adapted to be pushed against a lower surface of the electrode side retention body **52** and an upper surface of the land side retention body **55** by a repulsion of the spring **13**, respectively.

The cylindrical rod **11***h* is received in a bore formed in the cylindrical hollow rod **12***h*, and the spring **13** is arranged in a periphery of the cylindrical rod **11***h* and the cylindrical hollow rod **12***h*. The electrode side contact terminal **11** and the land side contact terminal **12** are electrically connected with each other by at least either one of the cylindrical rod **11***h* and the cylindrical hollow rod **12***h* or the spring **13**.

Here, the construction of the contact probe **20** is the same as the construction of the aforementioned contact probe **10**. Therefore, the explanation of the contact probe **20** will be omitted by having the first digit "1" of the reference numerals replaced by another digit "2" and using the same digits for the second and the third digits in the reference numerals in the drawings.

As shown in FIG. **1** and FIG. **2**, the contact probe **10** and the contact probe **20** are arranged in such a manner that the electrode side inclined surfaces **11***f* and the land side inclined surfaces **21***f* are held in an opposite relationship with respect to each other and that the land side inclined surface **12***f* and the land side inclined surface **22***f* are held in a face to face relationship with respect to each other.

By the construction as described above, an apex portion of the electrode side inclined surface **11***f* and an apex portion of the electrode side inclined surface **21***f* are approached with respect to each other to be brought into contact with the solder ball **61**. An interval between the apices can be set to approximately 0.08 mm.

Further, by the construction as set forth above, an apex portion of the land side inclined surface **12***f* and an apex portion of the land side inclined surface **22***f* are spaced apart from each other to be brought into contact with the land **71** and the land **72**, respectively. An interval between the apices can be set to approximately 0.6 mm.

Next, a peripheral construction of the contact probe **10** and the contact probe **20** will be explained with reference mainly to FIG. **3** and appropriately to FIGS. **1** and **2**.

The housing body **51**, which is constituted by an electrically insulating material, has a through bore **51***a* and a through bore **51***b* formed therein, the through bore **51***a* receiving the contact probe **10** and the through bore **51***b* receiving the contact probe **20** (FIG. 3B).

On the upper surface of the housing body **51** is arranged the electrode side retention body **52** constituted by an electrically insulating material. On the upper surface of the retention body **52** is provided the pressing plate **53** which is secured to the housing body **51** by the screw **56**.

The electrode side retention body **52** has the through bore **52***a* and the through bore **52***b* formed therein, the through bore **52***a* and the through bore **52***b* respectively shaped in a semi circle as viewed from above (FIG. 3A). The through bore **52***a* and the through bore **52***b* respectively have a straight line portion forming a plane adapted to be held in a face to face relationship with respect to the rotation preventing surfaces **11***c* and **21***c*, respectively. By the construction as set forth above, the rotation preventing surfaces **11***c* and **21***c* can prevent the electrode side contact terminals **11** and **21** from being rotated around each of the center axes.

On the lower surface of the housing body **51** is arranged the land side retention body **55**, which is secured to the housing body **51** by the screw **56**.

The land side retention body **55** has the through bore **55***a* and the through bore **55***b* formed therein, the through bore **55***a* and the through bore **55***b* respectively shaped in a rectangle as viewed from above (FIG. 3C). The through bore **55***a* and the through bore **55***b* respectively have a facing surface held in a face to face relationship with respect to the rotation preventing surfaces **12***c* and **22***c*, respectively. By the construction as set forth above, the rotation preventing surfaces **12***c* and **22***c* can prevent the electrode side contact terminals **12** and **22** from being rotated around each of the center axes.

Next, an assembly process of the Kelvin inspection fixture **100** will be briefly explained hereinafter. First, the land side retention body **55** is secured to the housing body **51** by the screw **56**. Then, the contact probe **10** and **20** are inserted into the through bore **51***a* and the **51***b*, respectively. At this time, the land side contact terminals **12** and **22** are inserted into the through bore **55***a* and **55***b*, respectively, in such a manner that the land side inclined surface **12***f* of the contact probe **10** and the land side inclined surface **22***f* of the contact probe **20** are held in the face to face relationship with respect to each other.

Subsequently, a direction of each of the electrode side inclined surface **11***f* and **21***f* is adjusted in such a manner that the electrode side inclined surface **11***f* of the contact probe **10** and the electrode side inclined surface **21***f* of the contact probe **20** are held in the opposite relationship with respect to each other.

Thereafter, the electrode side retention body **52** and the pressing plate **53** are serially disposed on the housing body **51** and the pressing plate **53** is secured to the housing body **51** by the screw **54**.

The contact probes **30** and **40** are assembled in a similar way as set forth above for the contact probes **10** and **20**.

The foregoing description has been directed to a case in which the electrode of the IC **60** is constituted by the solder ball **61** and **62**. However, the present invention is not limited to this case, and the present invention can be applied to a case in which the IC **60** has narrow pitch planar electrodes.

As can be understood from the foregoing description, the Kelvin inspection fixture **100** according to the present embodiment is constructed in such a manner that the electrode side inclined surface **11***f* and the electrode side inclined surface **21***f* are held in the opposite relationship with respect to each other, so that the electrode side inclined surface **11***f* and the electrode side inclined surface **21***f* can be securely brought into contact with the solder ball **61**, even in such a case of narrow pitch that each of the solder balls **61** and **62** has a diameter of approximately 0.26 mm, with an interval of approximately 0.5 mm between the solder balls **61** and **62**.

Further, the Kelvin inspection fixture **100** according to the present embodiment is constructed in such a manner that the electrode side inclined surface **11***f* and the electrode side inclined surface **21***f* are held in the opposite relationship with respect to each other, so that there is generated a moment of force operated in a direction to have the electrode side contact terminals **12** and **22** moved closer to each other in response to the IC **60** being mounted. As a result, the cylindrical rods **11***h* and **21***h* are securely brought into contact with the cylindrical hollow rod **12***h* of the land side contact terminal **21** and the cylindrical hollow rod **22***h* of the land side contact terminal **22**, respectively.

Further, the Kelvin inspection fixture **100** according to the present embodiment is constructed in such a manner that the land side inclined surface **12***f* and the land side inclined surface **22***f* are held in the face to face relationship with respect to each other, so that there is no need to narrow pitches of the lands **71**-**74** of the circuit substrate **70** and the wiring connected to the lands **71**-**74**.

Therefore, the Kelvin inspection fixture **100** according to the present embodiment can cope with narrow pitches of the electrode regardless of the shape of the electrode of the inspection object to be inspected, and, moreover, can avoid an increase in manufacturing cost of the circuit substrate **70**.

Another Embodiment 1

The present invention can be applied to other embodiments than the aforementioned embodiment. For example, the Kelvin inspection fixture **100** according to the present invention can be constructed to have the aforementioned electrode side contact terminal **11** replaced by an electrode side contact terminal as shown in FIG. **4**.

As shown in FIG. **4**, the electrode side contact terminal **14** has a V shaped groove formed at an apex portion of an electrode side inclined surface **14***h*, so that the electrode side contact terminal **14** has two apices **14***j* and **14***k*. Hereinafter, the electrode side contact terminal applied to the contact probe **20** will be referred to as an electrode side contact terminal **24**. The electrode contact terminals **14** and **24** are brought into contact with the solder ball **61** as shown in FIG. **5**.

FIG. **5**A shows a view of the electrode side contact terminals **14** and **24** as viewed from the solder ball **61** side, while FIG. **5**B shows an A arrow view and a B arrow view as indicated by arrows in FIG. **5**A. As shown in FIG. **5**, four apices **14***j*, **14***k*, **24***j* and **24***k* are brought into contact with the solder ball **61** in this embodiment, thereby making it possible to obtain a more stable contact state. Here, each of the grooves formed at the apex portions of the electrode side contact terminals **14** and **24** is not limited to a V shape, and a plurality of grooves may be arranged so that three or more apices are formed.

Another Embodiment 2

Further, in the aforementioned embodiment, the Kelvin inspection fixture **100** is constructed in such a manner that the electrode side inclined surface **11***f* and the land side inclined surface **12***f* are parallel with respect to each other and the electrode side inclined surface **21***f* and the land side inclined surface **22***f* are parallel with respect to each other. However, the Kelvin inspection fixture according to the present invention can otherwise be constructed as shown in FIG. **6**.

As shown in FIG. **6**, contact probes **10**A and **20**A include a land side contact terminal **15** and **25**, respectively. The land side contact terminal **15** has a land side inclined surface $\mathbf{15}f_1$ and $\mathbf{15}f_2$ formed thereon, while the land side contact terminal **25** has a land side inclined surface $\mathbf{25}f_1$ and $\mathbf{25}f_2$ formed thereon. The land side inclined surface $\mathbf{15}f_1$ is not arranged in parallel with respect to the electrode side inclines surface **11***f*, while the land side inclined surface $\mathbf{25}f_1$ is not arranged in parallel with respect to the electrode side inclines surface **21***f*.

Here, the structure of the land side inclined surfaces $\mathbf{15}f_1$ and $\mathbf{15}f_2$ can be applied to the electrode side contact terminal **11**, and the structure of the land side inclined surfaces $\mathbf{25}f_1$ and $\mathbf{25}f_2$ can be applied to the electrode side contact terminal **21**.

Another Embodiment 3

Further, the Kelvin inspection fixture **100** according to the present invention may be constructed as shown in FIG. **7**. As shown in FIG. **7**, each of contact probes **10**B and **20**B has a land side contact terminal **16** including a top end portion therein and a land side contact terminal **26** including a top end portion therein, respectively. The top end portion of the land side contact terminal **16** is protruding from a through bore **57***b* formed in the land side retention body **57** to have a cone shaped land side inclined surface **26***f* at a top end thereof. In this construction, there is not required a means to prevent a rotation of the land side contact terminals **16** and **26** around the center axes thereof.

Another Embodiment 4

Furthermore, the Kelvin inspection fixture **100** according to the present invention may be constructed as shown in FIG. **8**. As shown in FIG. **8**, each of contact probes **10**C and **20**C has the same elements as those of the contact proves **10** and **20** as shown in FIG. **3**, except that a direction of each of the land side inclined surface **12***f* and **22***f* shown in FIG. **8** is different from a direction of the land side inclined surface **12***f* and **22***f* shown in FIG. **3**.

To be more specific, as shown in FIG. **8**C, the land side contact terminal **12** of the contact probe **10**C is the land side terminal **12** as shown in FIG. **3** rotated 90 degrees in a clockwise direction as viewed from below. However, the rotation angle of the land side contact terminals **12** and **22** is not restricted to 90 degrees.

The land side retention body **55** has a rectangular through bore **55***c* formed therein as viewed from below. The through bore **55***c* includes a facing surface held in an opposite relationship with respect to the rotation preventing surfaces **12***c* and **22***c*. By the construction as set forth above, the rotation preventing surfaces **12***c* and **22***c* can prevent the land side contact terminals **12** and **22** from being rotated around each of the center axes.

Second Embodiment

FIG. **9** is a view showing a Kelvin inspection fixture **200** according to the second embodiment of the present invention.

The Kelvin inspection fixture **200** has a housing body **81** and a retention body **82** provided therein.

The housing body **81** has a through bore **81***a* provided therein, and is adapted to retain the contact probes **10** and **20** through the through bore **81***a*.

The retention body **82** is integrally formed with an electrically insulating material. The retention body **82** has an electrode side retention body **82***a*, a land side retention body **82***b* and a connection portion **82***c* adapted to connect the electrode side retention body **82***a* and the land side retention body **82***b*.

The electrode side retention body **82***a* has semi circular through bores **82***d* and **82***e* arranged therein as viewed from above (FIG. **9**A). By the construction as set forth above, the rotation preventing surfaces **11***c* and **21***c* can prevent the electrode side contact terminals **11** and **21** from being rotated around each of the center axes. Further, the land side retention body **82***b* is rectangular in shape as viewed from below. By the construction as set forth above, the rotation preventing surfaces **11***c* and **21***c* can prevent the electrode side contact terminals **11** and **21** from being rotated around each of the center axes (FIG. **9**C).

Next, an assembly process of the Kelvin inspection fixture **200** will be briefly explained hereinafter. First, the contact probes **10** and **20** are incorporated into the retention body **82**. Specifically, the electrode side contact terminal **11** of the contact probe **10** is inserted into the through bore **82***d*, and the land side surface **12***b* of the land side contact terminal **12** is placed on an upper surface of the land side retention body **82** while compressing the spring **13**. The contact probe **20** is incorporated into the retention body **82** in a similar way. As a result, the electrode side inclined surface **11***f* and the electrode side inclined surface **21***f* are held in the opposite relationship with respect to each other, while the land side inclined surface **12***f* and the land side inclined surface **21***f* are held in the face to face relationship with respect to each other. Hereinafter, the retention body **82** with the contact probes **10** and **20** incorporated therein will be referred to as a “contact probe assembly”.

Subsequently, the contact probe assembly is inserted into the through bore **81***a* from an upper surface side of the housing body **81**. Then, the pressing plate **53** is laid on an upper surface of the housing body **81** to be secured to the housing body **81** with the screw **54**.

As can be understood from the foregoing description, the Kelvin inspection fixture **200** according to the present embodiment is constructed to incorporate a preliminarily assembled contact probe assembly into the housing body **81**, thereby making it easy to assemble the Kelvin inspection fixture **200**.

Third Embodiment

FIG. **10** is a view showing a Kelvin inspection fixture **300** according to the third embodiment of the present invention.

The Kelvin inspection fixture **300** has a housing body **91** and a retention body **92** provided therein.

The housing body **91** has a through bore **91***a*, a receiving surface **91***b* and a through bore **91***c* formed therein, the through bore **91***a* retaining the contact probes **10** and **20**, the receiving surface **91***b* receiving a land side retention body **92** described hereinafter and the through bore **91***c* allowing the land side contact terminals **12** and **22** to penetrate therethrough.

The retention body **92** is constituted by an electrically insulating material. The retention body **92** is constructed in, a double structure consisting of an integrated structure and another structure, the integrated structure inclusive of an electrode side retention body **92***a*, a connection portion **92***c* and a cover member **92***d*, the another structure inclusive of a land side retention body **92***b*. The cover member **92***d* covers an outer peripheral of the contact probes **10** and **20**.

The electrode side retention body **92***a* has a semi circle shaped through bores **92***e* and **92***f* arranged therein as viewed from above (FIG. **10**A). The through bores **92***e* and **92***f* have a facing surface held in a face to face relationship with respect to the rotation preventing surfaces **11***c* and **21***c*, respectively. By the construction as set forth above, the rotation preventing surfaces **11***c* and **21***c* can prevent the electrode side contact terminals **11** and **21** from being rotated around each of the center axes.

The land side retention body **92***b* has a rectangular through bores **92***g* and **92***h* arranged therein as viewed from below (FIG. **10**C). The through bores **92***g* and **92***h* have a facing surface held in a face to face relationship with respect to the rotation preventing surfaces **12***c* and **22***c*, respectively. By the construction as set forth above, the rotation preventing surfaces **12***c* and **22***c* can prevent the land side contact terminals **12** and **22** from being rotated around each of the center axes.

Next, an assembly process of the Kelvin inspection fixture **300** will be briefly explained hereinafter. First, the contact probes **10** and **20** are incorporated into the retention body **92**. Specifically, the electrode side contact terminal **11** of the contact probe **10** is inserted into the through bore **92***e*, and the land side contact terminal **21** of the contact probe **20** is inserted into the through bore **92***f*. As a result, the electrode side inclined surface **11***f* and the electrode side inclined surface **21***f* are held in the opposite relationship with respect to each other.

Subsequently, a direction of each of the land side inclined surface **12***f* and **22***f* is adjusted in such a manner that the land side inclined surface **12***f* of the contact probe **10** and the land side inclined surface **22***f* of the contact probe **20** are held in the face to face relationship with respect to each other.

Further, the land side retention body **92***b* is attached to the connection portion **92***c* and the cover member **92***d* to be finally bonded by for example a bonding material, while compressing the springs **13** and **23**. The contact probe assembly thus bonded is inserted into the through bore **91***a* from an upper surface side of the housing body **91**.

Then, the pressing plate **53** is laid on the upper surface of the housing body **91** to be secured to the housing body **91** with the screw **54**.

As can be understood from the foregoing description, the Kelvin inspection fixture **300** according to the present embodiment is constructed to incorporate a preliminarily assembled contact probe assembly into the housing body **91**, thereby making it easy to assemble the Kelvin inspection fixture **300**.

INDUSTRIAL APPLICABILITY

The Kelvin contact probe and the Kelvin inspection fixture according to the present invention can cope with narrow pitches of the electrode regardless of the shape of electrode of the inspection object to be inspected, and, moreover, can avoid an increase in manufacturing cost of the circuit substrate, so that the Kelvin contact probe structure and the Kelvin inspection fixture according to the present invention is useful as the Kelvin contact probe structure and the Kelvin inspection fixture to be used in inspection of the resistance value between the electrodes of the semiconductor integrated circuits.

EXPLANATION OF REFERENCE NUMERALS

10, **20**, **30** contact probe
10A, **10**B, **10**C, **20**A, **20**B, **20**C contact probe
11, **14**, **21**, **24** electrode side contact terminal
11*f*, **14***f*, **21***f*, **24***f* electrode side inclined surface
11*c*, **12***c*, **21***c*, **22***c* rotation preventing surface
11*h*, **21***h* cylindrical rod
12, **15**, **16**, **22**, **25**, **26** land side contact terminal
12*f*, **15**f_1, **15**f_2, **16***f*, **22***f*, **25**f_1, **25**f_2, **26***f* land side inclined surface
12*h*, **22***h* cylindrical hollows rod
14*i* V shaped groove
14*j*, **14***k* apex
51, **81**, **91** housing body
51*a*, **51***b*, **81***a*, **91***a* through bore
52, **82***a*, **92***a* electrode side retention body
52*a*, **52***b*, **82***d*, **82***e*, **92***e*, **92***f* through bore
53 pressing plate
54, **56** screw
55, **57**, **82***b*, **92***b* land side retention body
55*a*, **55***b*, **55***c*, **57***a*, **57***b*, **91***c*, **92***g*, **92***h* through bore
60 IC
61, **62** solder ball
70 circuit substrate
71, **72**, **73**, **74** land
82, **92** retention body
82*c*, **92***c* connection portion
91*b* receiving surface
92*d* cover member
100, **200**, **300** Kelvin inspection fixture

The invention claimed is:

1. A Kelvin contact probe structure, comprising: two contact probes including one contact probe and the other contact probe, and axially arranged in parallel with each other to have one electrode electrically connected with two lands, and the electrode being provided on an inspection object to be inspected, and the two lands being provided on a circuit substrate, in which

each of the one contact probe and the other contact probe has an electrode side contact terminal and a land side contact terminal provided therein, the electrode side contact terminal arranged in an electrode side to be contactable with the electrode, the land side contact terminal being arranged in a land side to be contactable with the land, each of the one contact probe and the other contact probe includes the electrode side contact terminal contactable with the electrode, the land side contact terminal contactable with the land and a metal spring arranged between the electrode side contact terminal and the land side contact terminal,

the electrode side contact terminal includes a disk shaped electrode side contact terminal flange portion, an electrode side contact terminal rotation preventing portion, an electrode side inclined surface portion and a cylindrical rod, the disk shaped electrode side contact terminal flange portion having an electrode side surface and a land side surface, the electrode side contact terminal rotation preventing portion stretching from the electrode side surface of the electrode side contact terminal flange portion to be defined by a plate shaped electrode side contact terminal rotation preventing surface and a semi arc shaped electrode side contact terminal semi arc surface, the electrode side inclined surface portion defined by a surface inclined from center of a top end of the electrode side contact terminal semi arc surface toward the electrode side contact terminal flange portion, the cylindrical rod stretching from center of the land side surface of the electrode side contact terminal flange portion and being smaller in diameter than the electrode side contact terminal flange portion,

the land side contact terminal includes a disk shaped land side contact terminal flange portion, a land side contact terminal rotation preventing portion, a land side inclined surface portion and a cylindrical hollow rod, the disk shaped land side contact terminal flange portion having a land side surface and an electrode side surface, the land side contact terminal rotation preventing portion stretching from the land side surface of the land side contact terminal flange portion to be defined by a plate shaped land side contact terminal rotation preventing surface and a semi arc shaped land side contact terminal semi arc surface, the land side inclined surface portion defined by a surface inclined from center of a top end of the land side contact terminal semi arc surface toward the land side contact terminal flange portion, the cylindrical hollow rod stretching from center of the electrode side surface of the land side contact terminal flange portion and being smaller in diameter than the land side contact terminal flange portion to receive the cylindrical rod,

the metal spring being arranged between the land side surface of the electrode side contact terminal flange portion and the electrode side surface of the land side contact terminal flange portion, and

the one contact probe and the other contact probe being arranged in such a manner that the electrode side inclined surfaces faces are held in an opposite relationship with respect to each other and that the land side inclined surfaces are held in a face to face relationship with respect to each other.

2. The Kelvin contact probe structure as set forth in claim **1**, in which each of the electrode side contact terminals has a plurality of apices formed by at least one groove arranged at a top portion of the electrode side inclined surface.

3. A Kelvin inspection fixture comprising the Kelvin contact probe structure as set forth in claim **1**, which further comprises:

a housing body provided therein with a through bore and adapted to retain the one contact probe and the other contact probe through the through bore;

an electrode side retention body that retains the electrode side contact terminal; and

a land side retention body that retains the land side contact terminal.

4. The Kelvin inspection fixture as set forth in claim **3**, which further comprises a connection portion arranged between the one contact probe and the other contact probe, the connection portion connecting the electrode side holder and the land side holder.

5. The Kelvin inspection fixture as set forth in claim **4**, in which each of the one contact probe and the other contact probe has an outer periphery, and which further comprises a cover member that covers the outer periphery of the one contact probe and the other contact probe.

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