



(11) **EP 2 242 145 B9**

(12) **CORRECTED EUROPEAN PATENT SPECIFICATION**

(15) Correction information:
Corrected version no 1 (W1 B1)
Corrections, see
Claims EN 1

(51) Int Cl.:
H01R 4/06 (2006.01)

(86) International application number:
PCT/JP2008/051432

(48) Corrigendum issued on:
04.09.2013 Bulletin 2013/36

(87) International publication number:
WO 2009/096013 (06.08.2009 Gazette 2009/32)

(45) Date of publication and mention
of the grant of the patent:
08.05.2013 Bulletin 2013/19

(21) Application number: **08704195.0**

(22) Date of filing: **30.01.2008**

(54) **TERMINAL JOINING STRUCTURE AND TERMINAL JOINING METHOD**

ANSCHLUSSVERBINDUNGSSTRUKTUR UND ANSCHLUSSVERBINDUNGSVERFAHREN
STRUCTURE D'ASSEMBLAGE DE BORNE ET PROCÉDÉ D'ASSEMBLAGE DE BORNE

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT
RO SE SI SK TR**

- **HISAMORI, Yoichi**
Tokyo 100-8310 (JP)
- **ONO, Yoshitaka**
Tokyo 100-8310 (JP)
- **KARITA, Toshikazu**
Tokyo 100-8310 (JP)
- **TAKAHASHI, Tetsuya**
Tokyo 100-8310 (JP)

(43) Date of publication of application:
20.10.2010 Bulletin 2010/42

(73) Proprietor: **Mitsubishi Electric Corporation**
Tokyo 100-8310 (JP)

(74) Representative: **Zech, Stefan Markus et al**
Meissner, Bolte & Partner GbR
Postfach 86 06 24
81633 München (DE)

- (72) Inventors:
- **OKA, Kohei**
Tokyo 100-8310 (JP)
 - **SAKAUE, Shozo**
Sanda-shi
Hyogo 669-1513 (JP)
 - **KITAYAMA, Shunichi**
Sanda-shi
Hyogo 669-1513 (JP)

(56) References cited:

JP-A- 7 192 791	JP-A- 7 249 882
JP-A- 62 162 304	JP-U- 62 118 351
US-A- 4 753 615	US-A- 5 365 654

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 2 242 145 B9

Description**TECHNICAL FIELD**

[0001] The present invention relates to a terminal joining structure for high current usage including a conductor substrate such as a busbar, a circuit board, or a laminated structure of a circuit board and a substrate parallel body, as well as including a terminal such as a bush or a fastener and relates to a terminal joining method.

BACKGROUND ART

[0002] In a conventional terminal joining structure for high current usage and a terminal joining method therefor, a flange portion is formed at one end of a tubular terminal body and a pair of protrusions are formed at the outer periphery of that end of the terminal body which is on the opposite side of the flange portion. Besides, a hole for inserting the tubular terminal body is formed on a conductor substrate and grooves through which the protrusions can pass on the inner surface of the hole are formed. Upon inserting the terminal body in the hole, the terminal is rotated for shifting the positions of the projections and the grooves out of alignment so that the conductor substrate is sandwiched between the projections and the flange portion. In that condition, the terminal body is soldered to the conductor substrate. Thus, the terminal body is fixed to the conductor substrate by performing clamping using the projections and the flange portion and performing soldering (e.g., see Patent Literature 1).

[0003] Patent Literature 1: Japanese Patent Application Laid-open No. H7-249882

[0004] US 5,365,654 is considered to be the closest prior art as it discloses a terminal joining structure as in the preamble of claim 1.

DISCLOSURE OF INVENTION**PROBLEM TO BE SOLVED BY THE INVENTION**

[0005] In the conventional terminal joining structure for high current usage and the terminal joining method therefor as described above, joining with the use of soldering or brazing leads to an increase in the number of steps during the manufacturing process, which runs counter to cutting down the manufacturing cost. Moreover, in the conventional terminal joining structure, the joint region of the terminal and the conductor substrate is weak in mechanical strength. Hence, if exposed to a high screw tightening torque, there is a possibility that the joint region rotates.

[0006] The present invention has been made to solve the above problems in the conventional technology and it is an object of the present invention to provide a terminal joining structure and a terminal joining method that enable achieving simplification in the manufacturing process and achieving a strong joining force.

MEANS FOR SOLVING PROBLEM

[0007] To solve the above problems and achieve the object, a terminal joining structure is given in claim 1; a corresponding method is seen in claim 6.

EFFECT OF THE INVENTION

[0008] According to an aspect of the present invention, it is possible to achieve a pronounced advantage over the conventional technology since just a simple manufacturing process of caulking or screw-coupling the ends of a terminal that sandwiches a conductor substrate enables achieving a joining force. Moreover, a strong joining force may be achieved by making a taper formed on a barrel portion of the terminal cause plastic deformation in the rim of a through-hole on the conductor substrate so that the rim is expanded outward.

BRIEF DESCRIPTION OF DRAWINGS**[0009]**

FIG. 1 is an exploded perspective view of a terminal joining structure for explaining a terminal joining structure and a terminal joining method according to a first embodiment of the present invention.

FIG. 2 is a transverse sectional view of the terminal joining structure during joining of a terminal to a conductor substrate according to the first embodiment. FIG. 3 is a perspective view of the terminal joining structure upon completion of joining the terminal to the conductor substrate according to the first embodiment.

FIG. 4 is a transverse sectional view of the terminal joining structure upon completion of joining the terminal to the conductor substrate according to the first embodiment.

FIG. 5 is an enlarged transverse sectional view of portion A illustrated in FIG. 4.

FIG. 6 is a graph representing a relation of fixing strength and adhesiveness between the terminal and the conductor substrate with the gradient angle of a taper according to the first embodiment.

FIG. 7 is a transverse sectional view of a condition when the terminal is joined to the conductor substrate using a caulking pin for fastening.

FIG. 8 is a transverse sectional view of a condition when the terminal is joined to the conductor substrate using a caulking pin for fastening that has a different shape.

FIG. 9 is a transverse sectional view of another example of the terminal joining structure according to the first embodiment.

FIG. 10 is a front view of a through-hole formed on a conductor substrate representing a terminal joining structure according to a second embodiment of the present invention.

FIG. 11 is a table of rotational resistance torque evaluation and adhesiveness evaluation for a terminal and the conductor substrate according to the second embodiment.

FIG. 12 is a front view of a through-hole formed on a conductor substrate representing another example of a terminal joining structure according to the second embodiment of the present invention.

FIG. 13 is a perspective view of a terminal joining structure according to a first example in which a terminal has been joined to a conductor substrate.

FIG. 14 is a transverse sectional view of a terminal joining structure according to a second example in which a terminal has been joined to a conductor substrate.

EXPLANATIONS OF LETTERS OR NUMERALS

[0010]

10, 10B, 110 Ring

10a Edge face of ring on axis-direction substrate-side

10b Female screw of ring

11A Outside chamfer

11B Substrate-side chamfer

20, 120, 220 Conductor substrate (busbar)

120a, 220a Serrations on through-hole rim

21, 121, 221 Through-hole

30, 30B, 130 Terminal

31, 31B, 131 Tubular barrel portion

31a Plastically-deforming part of barrel-portion opening edge

31b Male screw threaded on tubular barrel portion

32, 132 Flange portion

32a Edge face of flange portion on axis-direction substrate-side

32b Female screw threaded on inner peripheral surface of flange portion

33 Taper

32a Edge face of flange portion on axis-direction conductor-substrate-side

40, 50 Caulking pin for fastening

40a, 50a Pressing surface of caulking pin for fastening

41, 51 Ring holding member

BEST MODE(S) FOR CARRYING OUT THE INVENTION

[0011] Exemplary embodiments of a terminal joining structure and a terminal joining method according to the present invention are described in detail below with reference to the accompanying drawings. The present invention is not limited to these exemplary embodiments.

First embodiment.

[0012] FIG. 1 is an exploded perspective view of a terminal joining structure for explaining a terminal joining structure and a terminal joining method according to a first embodiment of the present invention. FIG. 2 is a transverse sectional view of the terminal joining structure during joining of a terminal to a conductor substrate. FIG. 3 is a perspective view of the terminal joining structure upon completion of joining the terminal to the conductor substrate. FIG. 4 is a transverse sectional view of the terminal joining structure upon completion of joining the terminal to the conductor substrate. FIG. 5 is an enlarged transverse sectional view of portion A illustrated in FIG. 4.

[0013] In the terminal joining structure according to the present embodiment, a terminal 30 is joined to a conductor substrate (busbar) 20. Although the conductor substrate 20 has, in practice, a greater two-dimensional expansion than the dimensions illustrated in drawings; in FIGS. 1 and 3, a complete diagrammatic representation thereof is not given and only the portion in the vicinity of the terminal 30 is illustrated in a cut-out manner in a rectangular shape. The terminal joining structure includes the terminal 30, the conductor substrate 20, and a ring 10. The conductor substrate 20 is manufactured from, for example, copper as an electrically-conductive material having plastic deformability and has a through-hole 21 opened thereon for fixing the terminal 30.

[0014] The terminal 30 is manufactured from a metal stock of, for example, copper or the like and includes a thin tubular barrel portion 31 and a thick tubular flange portion 32 that is integrally formed at the axis-direction end of the barrel portion 31. The outer diameter of the barrel portion 31 is such that fitting thereof in the through-hole 21 results in a clearance fit. In between the barrel portion 31 and the flange portion 32 is formed a taper 33 that decreases in diameter toward the barrel portion 31 and increases in diameter toward the flange portion 32. The diameter of the larger-diameter portion of the taper 33 is larger than the through-hole 21 formed on the conductor substrate 20.

[0015] The ring 10 is manufactured from a metal stock of, for example, copper or the like and fits on the barrel portion 31 on the opposite side of the conductor substrate 20. In the center of the ring 10 is formed a through-hole for inserting the barrel portion 31 of the terminal 30. Moreover, the through-hole has a substrate-side chamfer 11B formed on the end at the side of the conductor substrate 20 and has an outside chamfer 11A formed on the end on the opposite side of the conductor substrate 20.

[0016] The barrel portion 31 of the terminal 30 may be formed to have a thickness in the range of about 50% to about 300% with respect to the thickness of the conductor substrate 20. However, a very low thickness of the barrel portion 31 weakens the strength thereof against the load in the axis direction. On the other hand, a very high thickness of the barrel portion 31 makes it difficult to fix the ring 10 using caulking (flare processing). Hence, it is de-

sirable that the barrel portion 31 has a comparable thickness (in the range of 90% to 110%) to the thickness of the conductor substrate 20.

[0017] The taper 33 is formed in such a way that insertion thereof in the through-hole 21 of the conductor substrate 20 causes plastic deformation in the rim of the through-hole 21. FIG. 6 is a graph representing a relation of the gradient angle of the taper 33 with fixing strength and adhesiveness between the terminal 30 and the conductor substrate 20. When the gradient angle of the taper 33 is equal to or smaller than 5° with respect to the central axis, then the resistance force against the rotating torque is weak thereby making it difficult to achieve a predetermined fixing strength. In contrast, when the gradient angle of the taper 33 is equal to or greater than 20° with respect to the central axis, then the conductor substrate 20 undergoes warpage and the surface pressure distribution becomes unstable thereby causing deterioration in conductor substrate adhesiveness. Hence, it is desirable that the taper 33 has a gradient angle in the range of 5° to 20° and is particularly desirable that the taper 33 has a gradient angle of $15^\circ \pm 5^\circ$. Meanwhile, regarding the gradient height of the taper 33, it is desirable to have the gradient height in the range of about 100% to about 200% of the thickness of the conductor substrate 20 in the axis direction from an edge face 32a of the flange portion 32 and is particularly desirable to have the gradient height of about $150 \pm 10\%$. If the gradient height is too high, then the conductor substrate 20 undergoes warpage; while if the gradient height is too low, then sufficient adhesiveness cannot be achieved between the conductor substrate 20 and the terminal 30.

[0018] The through-hole for inserting the tubular barrel portion 31 of the terminal 30 is formed on the ring 10. Moreover, the substrate-side chamfer 11B and the outside chamfer 11A as described above are formed on both ends of the through-hole. At the time of caulking of the barrel portion 31 of the terminal 30, the plastically-deforming part of the opening edge of the barrel portion 31 gets pressed against the chamfer 11A of the ring 10. As a result, a resistance force against the rotating torque or a resistance force against pull-out are generated. Alternatively, a resistance force against the rotating torque or a resistance force against pull-out may also be generated when the taper 33 of the terminal 30 causes plastic deformation in the rim of the through-hole of the conductor substrate 20 so that the rim is expanded outward.

[0019] When the outside chamfer 11A makes an angle equal to or smaller than 20° with respect to the central axis, then the caulking force is not easily transmitted; while an angle equal to or greater than 40° causes deterioration in the shape formation using a caulking pin for fastening. Hence, it is desirable to have an angle in the range of 20° to 40° and is particularly desirable to have an angle of $30^\circ \pm 5^\circ$. Moreover, it is desirable that the chamfer 11A has a depth in the range of 100% to 200% with respect to the thickness of the barrel portion 31 of the terminal 30 in the axis direction from the edge face

of the ring 20. The angle and depth of the outside chamfer 11A determine an insertable depth for a caulking pin for fastening.

[0020] Explained below is the terminal joining method according to the present embodiment. FIG. 7 is a transverse sectional view of a condition when the terminal 30 is joined to the conductor substrate 20 by caulking the barrel portion 31 with a caulking pin for fastening 40. At the time of fixing the terminal 30 to the conductor substrate 20, the barrel portion 31 of the terminal 30 is first inserted in the through-hole 21 of the plate-like copper plate and then inserted in the through-hole of the ring 10 so that the conductor substrate 20 is sandwiched between the edge face 32a of the flange portion 32 and an edge face 10a of the ring 10. At that time, by pressing with a ring holding member 41, the taper 33 of the terminal 30 expands the rim of the through-hole 21 of the conductor substrate 20 outward so that the conductor substrate 20 moves inside a gap between the chamfer on the ring 10 and the taper 33 and gets tightly adhered thereat. In that condition, an open end part 31a of the barrel portion 31 of the terminal 30 is caulked (flare processed) outward by a cone-shaped pressing surface 40a of the caulking pin for fastening 40 so that the open end part 31a of the barrel portion 31 adheres tightly to the chamfer 11A of the ring 10. As a result, a caulking reaction force acting on the chamfers at both ends of the ring 10 causes a strong frictional force on each contacting surface. That achieves a joining with a strong resistance force against the screw tightening torque and against pull-out.

[0021] FIG. 8 is a transverse sectional view of a condition when the terminal 30 is joined to the conductor substrate 20 using a caulking pin for fastening 50 that has a different shape. The shape of a caulking pin for fastening is not limited to the cone shape as illustrated in FIG. 7 but may also be spherical as illustrated in FIG. 8. Moreover, it is desirable that a pressing surface 50a of the caulking pin that eventually abuts against the open end part 31a of the barrel portion 31 makes an angle of a comparable level to the angles of chamfers of the ring 10. For example, when each chamfer of the ring makes an angle of 30° , then it is desirable that the pressing surface 50a of the caulking pin that eventually abuts against the open end part 31a of the barrel portion 31 makes an angle in the range of 20° to 45° and is particularly desirable that the angle is $30^\circ \pm 5^\circ$.

[0022] Meanwhile, when strength evaluation of a joint region was performed for a prototype that was manufactured from copper as the material and, for example, manufactured with the outer diameter of the barrel portion 31 of the terminal 30 equal to 15 mm (maximum tolerance of 15-0.15 mm and minimum tolerance of 15-0.20 mm), with the gradient of the taper 33 equal to 10° , with the inner diameter of the ring 10 equal to 15 ± 0.05 mm, and with angles of the chamfers 11A and 11B of the ring 10 equal to 30° ; then it was confirmed that fastening of the caulking pin for fastening 40, with 25 KN of caulking force applied thereto, to the conductor substrate 20, having

thickness of 1.00 mm, has a pull-out strength of at least 3 kN and a rotational resistance torque of at least 5.5 Nm.

[0023] FIG. 9 is a transverse sectional view of another example of the terminal joining structure according to the present embodiment. In the terminal joining structure illustrated in FIG. 9, a female screw 32b is threaded on the inner peripheral surface of the thick tubular flange portion 32. In the terminal joining structure having such a structure, for example, another terminal may be screw-coupled to the female screw 32b. Meanwhile, both the barrel portion 31 and the flange portion 32 in the terminal 30 according to the present embodiment are assumed to be tubular in shape. However, as long as at least one end of the barrel portion 31 is formed to be tubular in shape, the open end thereof may be caulked thereby enabling implementation of the present invention.

Second embodiment.

[0024] FIG. 10 is a front view of a through-hole formed on a conductor substrate representing a terminal joining structure according to a second embodiment of the present invention. FIG. 11 is a table that illustrates rotational resistance torque evaluation and adhesiveness evaluation for a terminal and the conductor substrate according to the present embodiment. On a conductor substrate 120 according to the present embodiment, a through-hole 121 is formed to have serrations 120a on the rim. Apart from that, the structure is identical to that according to the first embodiment. Since the through-hole 121 in the conductor substrate 120 is formed to have the serrations 120a on the rim, adjusting the warpage of the conductor substrate 120 enables achieving an appropriate joining force. In the present embodiment, the serrations 120a are formed by first punching, on a circle equivalent to the diameter of a prepared hole, small-diameter holes at equal intervals and then punching the prepared hole. If the diameter of the small-diameter holes is relatively large; then, although the rotational resistance torque decreases, the conductor substrate 120 undergoes a smaller warpage and the surface pressure becomes stable thereby improving the adhesiveness. In addition, if the number of small-diameter holes is relatively large; then, although the rotational resistance torque decreases, the conductor substrate 20 undergoes a smaller warpage and the surface pressure becomes stable thereby improving the adhesiveness. Thus, it is desirable that the diameter of the small-diameter holes is in the range of about 150% to about 250% with respect to the thickness of the conductor substrate 20. Besides, it is desirable that the small-diameter holes are arranged in a concentric fashion with respect to the prepared hole at regular intervals and are arranged with the center-to-center spacing therebetween in the range of 1.4 times to 1.6 times of the diameter. For example, for a prototype manufactured with the abovementioned specifications; rotational resistance torque evaluation and adhesiveness evaluation is illustrated in FIG. 11.

[0025] FIG. 12 is a front view of a through-hole formed on a conductor substrate representing another example of a terminal joining structure according to the second embodiment of the present invention. In a conductor substrate 220 illustrated in FIG. 12, a through-hole 221 is formed to have triangular serrations 220a at the rim. Thus, a through-hole need not have a combination of large and small circles at the rim as illustrated in FIG. 10, but can also have the triangular serrations 220a at the rim as illustrated in FIG. 12. However, from the perspective of manufacturing manageability, a combination of circles is the desirable option.

First example.

[0026] FIG. 13 is a perspective view of a terminal joining structure according to a first example in which a terminal has been joined to a conductor substrate. Herein, the conductor substrate and a ring can have a noncircular cross-section surface perpendicular to the central axis. The terminal joining structure according to the present example includes a terminal 130 with a thin tubular barrel portion 131 in a cross-sectional hexagonal shape and a thick tubular flange portion 132 that is integrally formed at the axis-direction end of the barrel portion 131, which is formed in a cross-sectional hexagonal shape, and includes a ring 110 also in a cross-sectional hexagonal shape. Apart from that, the structure is identical to that described in the first embodiment. By forming the conductor substrate and the ring to have noncircular cross-section surfaces, it becomes possible to tie down the rotation of the terminal.

Second example.

[0027] FIG. 14 is a transverse sectional view of a terminal joining structure according to a second example of the present invention in which a terminal has been joined to a conductor substrate. In a terminal 30B according to the present example a male screw 31b is threaded on the inner peripheral surface of a tubular barrel portion 31B. Besides, on the inner peripheral surface of a ring 10B is threaded a female screw 10b. The ring 10B is fixed to the terminal 30B by fastening the female screw 10b with the male screw 31b.

[0028] Meanwhile, instead of using the caulking structure at the open end of the barrel portion described in the first two embodiments, the terminal 30B and the ring 10B may also be fixed by performing tapping at the outer peripheral surface of the barrel portion 31B and at the inner peripheral surface of the ring 10BB as described in the present example. At the time of sandwiching the conductor substrate 20, the taper 33 and the chamfer 11B cause plastic deformation in the rim of the through-hole on the conductor substrate 20 so that the rim is expanded outward thereby enabling a strong joining of the conductor substrate 20 and the terminal 30B.

INDUSTRIAL APPLICABILITY

[0029] In this way, the terminal joining structure and the terminal joining method according to the present invention are suitable for a terminal joining structure used in joining a terminal to a conductor substrate and particularly suitable for a terminal joining structure for high current usage.

Claims

1. A terminal joining structure comprising:

a terminal (30) including a thinner tubular barrel portion (31) and a thicker tubular flange portion (32) that is integrally formed at an axis-direction end of the barrel portion (31);
a conductor substrate (20, 120, 220) on which a through-hole (21, 121, 221) for inserting the barrel portion (31) is opened; and
a taper that increases in diameter toward the flange portion (32) is formed on the barrel portion (31), the diameter of a larger-diameter portion of the taper being larger than an inner diameter of the through-hole (21, 121, 221),

characterized by further comprising:

a ring (10, 10B, 110) that contacts with, and fits on, the barrel portion, wherein a substrate-side chamfer (11B) is formed at an inner diameter of the ring (10, 10B, 110) on an end portion at the side of the conductor substrate (20, 120, 220), wherein an outside chamfer is formed at the inner diameter of the ring (10, 10B, 110) on an end portion at a side opposite to the conductor substrate (20, 120, 220), wherein
a rim of the through-hole (21, 121, 221) of the conductor substrate (20, 120, 220) is pressed to the substrate-side chamfer (11B) of the ring (10, 10B, 110) by the taper that is formed on the barrel portion (31), the taper of the terminal (30) expands the rim of the through-hole of the conductor substrate (20, 120, 220) outward so that the conductor substrate moves inside a gap between the chamfer on the ring (10, 10B, 110) and the taper and gets tightly adhered thereat; and
the terminal (30) is caulked to cause radially outward expansion of an open end side of the barrel portion (31) along the outside chamfer (11A) of the ring (10, 10B, 110), and is fixed to the conductor substrate (20, 120, 220) together with the ring (10, 10B, 110), wherein the barrel portion (31) passes through the ring (10, 10B, 110).

2. The terminal joining structure according to claim 1,

wherein the through-hole (21, 121, 221) of the conductor substrate (20, 120, 220) is caulked so as to expand radially outward along the taper of the barrel portion (31).

3. The terminal joining structure according to claims 1 or 2, wherein the through-hole (21, 121, 221) is formed to have serrations at rim.

4. The terminal joining structure according to any one of claims 1 to 3, wherein the taper has a gradient angle of $15^{\circ} \pm 5^{\circ}$ with respect to a central axis and has an axis-direction height from a flange portion (32) edge face equal to 1.4 times to 1.6 times of thickness of the conductor substrate (20, 120, 220).5. The terminal joining structure according to claim 1, wherein the outside chamfer makes an angle $30^{\circ} \pm 5^{\circ}$ with respect to a central axis.

6. A terminal joining method comprising:

opening a through-hole (21, 121, 221) on a conductor substrate (20, 120, 220) for fixing a terminal (30);
forming, on a barrel portion (31) of the terminal (30) that includes the barrel portion (31) in tubular shape and a flange portion (32) that is integrally formed at an axis-direction end of the barrel portion (31), a taper that increases in diameter toward the flange portion (32), diameter of a larger-diameter portion of the taper being larger than inner diameter of the through-hole (21, 121, 221);

characterized by:

fitting, upon inserting the barrel portion (31) in the through-hole (21, 121, 221), a ring (10, 10B, 110) on to the barrel portion (31) at a side of the conductor substrate (20, 120, 220) which is opposite the flange portion (31); and
fixing that includes caulking the terminal (30) to cause radially outward expansion of the end on a side opposite to the conductor substrate (20, 120, 220), of the barrel portion (31) that passes through the ring (10, 10B, 110) and fixing the terminal (30) to the conductor substrate (20, 120, 220) together with the ring (10, 10B, 110).

7. The terminal joining method according to claim 6, wherein, before step of fitting the ring (10, 10B, 110) on the barrel portion (31), a chamfer is formed, in advance, at inner diameter of the ring (10, 10B, 110) corresponding to a position at which the barrel portion (31) is caulked.

8. The terminal joining method according to claims 6

or 7, wherein, at time of opening a through-hole (21, 121, 221) on the conductor substrate (20, 120, 220), the through-hole (21, 121, 221) is formed to have tooth-shaped rim.

5

Patentansprüche

1. Anschlussverbindungsstruktur, Folgendes aufweisend:

10

einen Anschluss (30), der einen dünneren rohrförmigen Trommelabschnitt (31) und einen dickeren rohrförmigen Flanschabschnitt (32) umfasst, der an einem Achsenrichtungsende des Trommelabschnitts (31) einstückig angeformt ist;

15

eine Leiterbasisplatte (20, 120, 220), auf der eine Durchgangsöffnung (21, 121, 221) zum Einführen des Trommelabschnitts (31) geöffnet ist; und

20

eine am Trommelabschnitt (31) ausgebildete Verjüngung, die zum Flanschabschnitt (32) hin im Durchmesser zunimmt, wobei der Durchmesser eines Abschnitts größeren Durchmessers der Verjüngung größer ist als ein Innendurchmesser der Durchgangsöffnung (21, 121, 221),

25

dadurch gekennzeichnet, dass sie darüber hinaus aufweist:

30

einen Ring (10, 10B, 110), der mit dem Trommelabschnitt in Kontakt kommt und auf diesen passt, wobei eine basisplattenseitige Schräge (11B) an einem Innendurchmesser des Rings (10, 10B, 110) an einem Endabschnitt auf der Seite der Leiterbasisplatte (20, 120, 220) ausgebildet ist, wobei eine außenliegende Schräge am Innendurchmesser des Rings (10, 10B, 110) an einem Endabschnitt auf einer der Leiterbasisplatte (20, 120, 220) entgegengesetzten Seite ausgebildet ist, wobei

35

ein Rand der Durchgangsöffnung (21, 121, 221) der Leiterbasisplatte (20, 120, 220) durch die Verjüngung, die am Trommelabschnitt (31) ausgebildet ist, zur basisplattenseitigen Schräge (11B) des Rings (10, 10B, 110) gepresst ist, wobei die Verjüngung des Anschlusses (30) den Rand der Durchgangsöffnung der Leiterbasisplatte (20, 120, 220) nach außen erweitert, so dass sich die Leiterbasisplatte in einem Spalt zwischen der Schräge am Ring (10, 10B, 110) und der Schräge bewegt und fest an diese angelegt wird; und

40

45

der Anschluss (30) verstemmt ist, um eine radial nach außen gerichtete Erweiterung einer Seite mit offenem Ende des Trommelabschnitts (31)

50

55

entlang der außenliegenden Schräge (11A) des Rings (10, 10B, 110) zu bewirken, und zusammen mit dem Ring (10, 10B, 110) an der Leiterbasisplatte (20, 120, 220) fixiert ist, wobei der Trommelabschnitt (31) durch den Ring (10, 10B, 110) hindurchtritt.

2. Anschlussverbindungsstruktur nach Anspruch 1, wobei die Durchgangsöffnung (21, 121, 221) der Leiterbasisplatte (20, 120, 220) verstemmt ist, um sich entlang der Verjüngung des Trommelabschnitts (31) radial nach außen zu erweitern.

3. Anschlussverbindungsstruktur nach Anspruch 1 oder 2, wobei die Durchgangsöffnung (21, 121, 221) mit Kerbverzahnungen am Rand ausgebildet ist.

4. Anschlussverbindungsstruktur nach einem der Ansprüche 1 bis 3, wobei die Verjüngung einen Steigungswinkel von $15^\circ \pm 5^\circ$ im Hinblick auf eine Mittelachse hat, und eine Achsenrichtungshöhe ausgehend von einer Randfläche des Flanschabschnitts (32) hat, die gleich dem 1,4-Fachen bis 1,6-Fachen der Dicke der Leiterbasisplatte (20, 120, 220) ist.

5. Anschlussverbindungsstruktur nach Anspruch 1, wobei die außenliegende Schräge einen Winkel von $30^\circ \pm 5^\circ$ im Hinblick auf eine Mittelachse bildet.

6. Anschlussverbindungsverfahren, Folgendes umfassend:

Öffnen einer Durchgangsöffnung (21, 121, 221) an einer Leiterbasisplatte (20, 120, 220) zum Fixieren eines Anschlusses (30);

Ausbilden, und zwar an einem Trommelabschnitt (31) des Anschlusses (30), der den Trommelabschnitt (31) in einer rohrförmigen Form und einen Flanschabschnitt (32) umfasst, der an einem Achsenrichtungsende des Trommelabschnitts (31) einstückig angeformt ist, einer Verjüngung, die zum Flanschabschnitt (32) hin im Durchmesser zunimmt, wobei der Durchmesser eines Abschnitts größeren Durchmessers der Verjüngung größer ist als ein Innendurchmesser der Durchgangsöffnung (21, 121, 221);

gekennzeichnet durch

Aufsetzen, und zwar nach dem Einsetzen des Trommelabschnitts (31) in die Durchgangsöffnung (21, 121, 221), eines Rings (10, 10B, 110) auf den Trommelabschnitt (31) auf einer Seite der Leiterbasisplatte (20, 120, 220), die dem Flanschabschnitt (31) entgegengesetzt ist; und

Fixieren, das ein Verstemmen des Anschlusses (30) beinhaltet, um eine radial nach außen gerichtete Erweiterung eines Endes auf einer der Leiterbasisplat-

te (20, 120, 220) entgegengesetzten Seite zu bewirken, des Trommelabschnitts (31), der **durch** den Ring (10, 10B, 110) hindurchtritt, und Fixieren des Anschlusses (30) an der Leiterbasisplatte (20, 120, 220) zusammen mit dem Ring (10, 10B, 110).

7. Anschlussverbindungsverfahren nach Anspruch 6, wobei vor dem Schritt des Aufsetzens des Rings (10, 10B, 110) auf den Trommelabschnitt (31) vorab eine Schräge an einem Innendurchmesser des Rings (10, 10B, 110) ausgebildet wird, die einer Position entspricht, an welcher der Trommelabschnitt (31) verstemmt wird.

8. Anschlussverbindungsverfahren den Ansprüchen 6 oder 7, wobei beim Öffnen der Durchgangsöffnung (21, 121, 221) an der Leiterbasisplatte (20, 120, 220) die Durchgangsöffnung (21, 121, 221) mit einem zahnförmigen Rand ausgebildet wird.

Revendications

1. Structure d'assemblage de borne comprenant :

une borne (30) incluant une partie barillet tubulaire plus mince (31) et une partie bride tubulaire plus épaisse (32) qui est solidaire d'une extrémité en sens axial de la partie barillet (31) ;
un substrat conducteur (20, 120, 220) sur lequel un trou traversant (21, 121, 221) permettant d'insérer la partie barillet (31) est ouvert ; et
un cône qui augmente en diamètre vers la partie bride (32) est formé sur la partie barillet (31), le diamètre d'une partie de grand diamètre du cône étant plus grand qu'un diamètre intérieur du trou traversant (21, 121, 221),

caractérisé en ce qu'elle comprend en outre :

une bague (10, 10B, 110) qui entre contact avec, et s'ajuste sur, la partie barillet, où un chanfrein côté substrat (11B) est formé sur un diamètre intérieur de la bague (10, 10B, 110) sur une partie terminale du côté du substrat conducteur (20, 120, 220), où un chanfrein extérieur est formé sur le diamètre intérieur de la bague (10, 10B, 110) sur une partie terminale du côté opposé au substrat conducteur (20, 120, 220), où un bord du trou traversant (21, 121, 221) du substrat conducteur (20, 120, 220) est appuyé sur le chanfrein côté substrat (11B) de la bague (10, 10B, 110) par le cône qui est formé sur la partie barillet (31), le cône de la borne (30) étend le bord du trou traversant du substrat conducteur (20, 120, 220) vers l'extérieur de sorte que le substrat conducteur se déplace à l'intérieur d'un interstice entre le chanfrein sur la bague (10,

10B, 110) et le cône et adhère fermement à celui-ci ; et

la borne (30) est matée pour provoquer une expansion radiale vers l'extérieur d'un côté terminal ouvert de la partie barillet (31) le long du chanfrein extérieur (11A) de la bague (10, 10B, 110), et est fixée au substrat conducteur (20, 120, 220) conjointement avec la bague (10, 10B, 110), où la partie barillet (31) passe à travers la bague (10, 10B, 110).

2. La structure d'assemblage de borne selon la revendication 1, où le trou traversant (21, 121, 221) du substrat conducteur (20, 120, 220) est maté de sorte à s'étendre radialement vers l'extérieur le long du cône de la partie barillet (31).

3. La structure d'assemblage de borne selon les revendications 1 ou 2, où le trou traversant (21, 121, 221) est formé pour présenter des cannelures sur le bord.

4. La structure d'assemblage de borne selon l'une quelconque des revendications 1 à 3, où le cône a un angle de gradient de $15^\circ \pm 5^\circ$ par rapport à un axe central et a une hauteur en sens axial, depuis une face latérale de la partie bride (32), égale à 1,4 fois à 1,6 fois l'épaisseur du substrat conducteur (20, 120, 220).

5. La structure d'assemblage de borne selon la revendication 1, où le chanfrein extérieur décrit un angle de $30^\circ \pm 5^\circ$ par rapport à un axe central.

6. Procédé d'assemblage de borne comprenant :

l'ouverture d'un trou traversant (21, 121, 221) sur un substrat conducteur (20, 120, 220) pour fixer une borne (30) ;
la formation, sur une partie barillet (31) de la borne (30) qui inclut la partie barillet (31) de forme tubulaire et une partie bride (32) qui est solidaire d'une extrémité en sens axial de la partie barillet (31), un cône qui augmente en diamètre vers la partie bride (32), le diamètre d'une partie de grand diamètre du cône étant plus grand que le diamètre intérieur du trou traversant (21, 121, 221) ;

caractérisé par

l'ajustage, lors de l'insertion de la partie barillet (31) dans le trou traversant (21, 121, 221), d'une bague (10, 10B, 110) sur la partie barillet (31) d'un côté du substrat conducteur (20, 120, 220) qui est opposé à la partie bride (31) ; et

la fixation qui inclut le matage de la borne (30) pour provoquer une expansion radiale vers l'extérieur de l'extrémité d'un côté opposé au substrat de conducteur (20, 120, 220), de la partie barillet (31) qui tra-

verse la bague (10, 10B, 110) et la fixation de la borne (30) sur le substrat conducteur (20, 120, 220) conjointement avec la bague (10, 10B, 110).

7. Le procédé d'assemblage de borne selon la revendication 6, où, avant l'étape d'ajustage de la bague (10, 10B, 110) sur la partie barillet (31), un chanfrein est formé, au préalable, sur un diamètre intérieur de la bague (10, 10B, 110) correspondant à une position à laquelle la partie barillet (31) est matée. 5 10
8. Le procédé d'assemblage de borne selon les revendications 6 ou 7, où, au moment de l'ouverture d'un trou traversant (21, 121, 221) sur le substrat conducteur (20, 120, 220), le trou traversant (21, 121, 221) est formé pour avoir un bord en forme de dents. 15

20

25

30

35

40

45

50

55

FIG.1

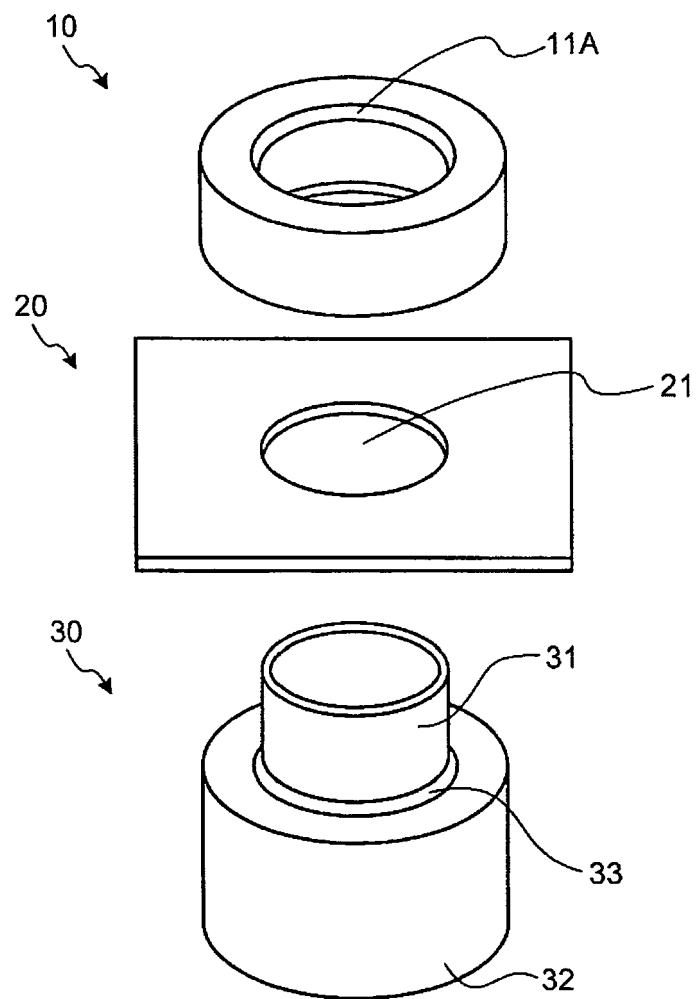


FIG.2

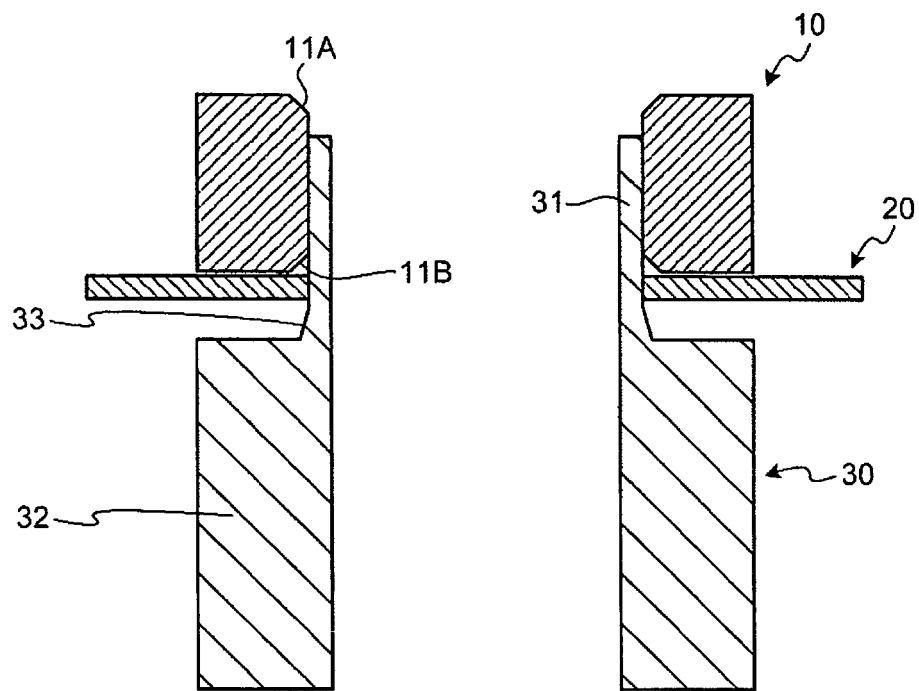


FIG.3

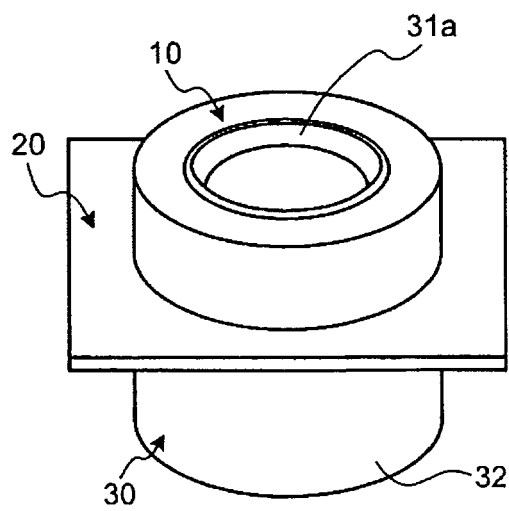


FIG.4

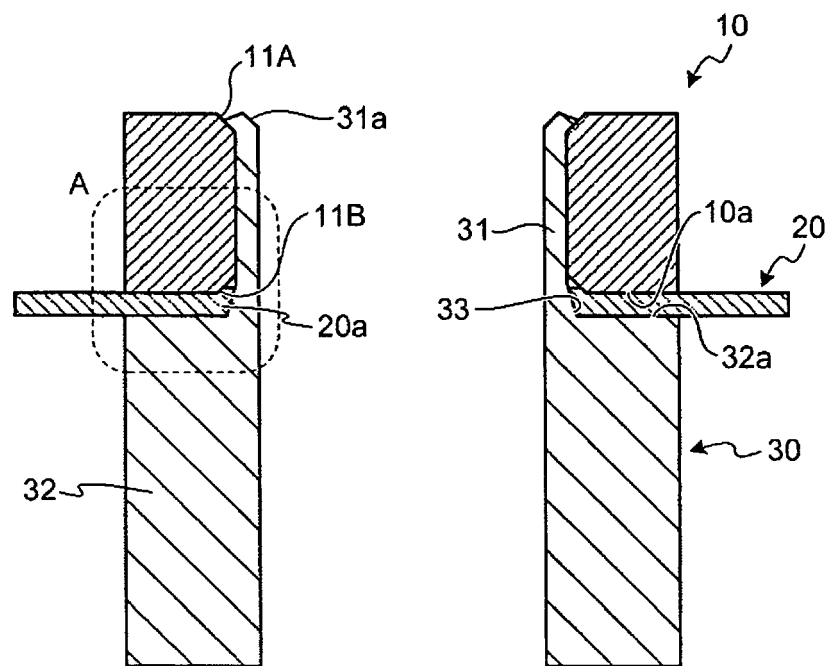


FIG.5

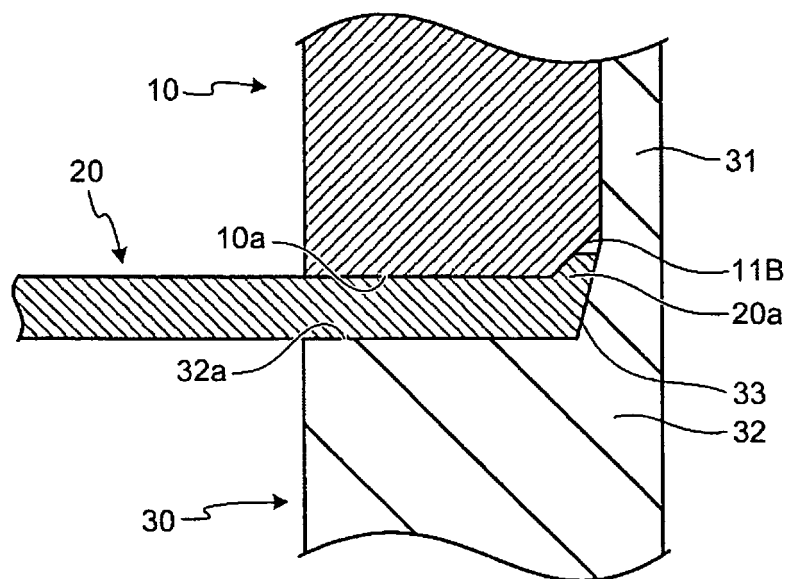


FIG.6

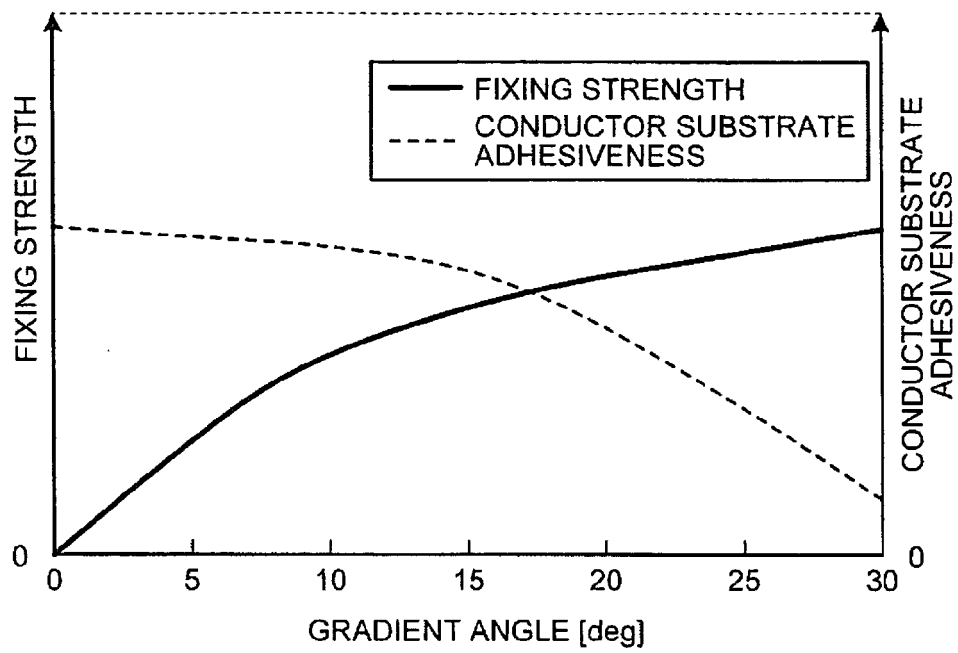


FIG.7

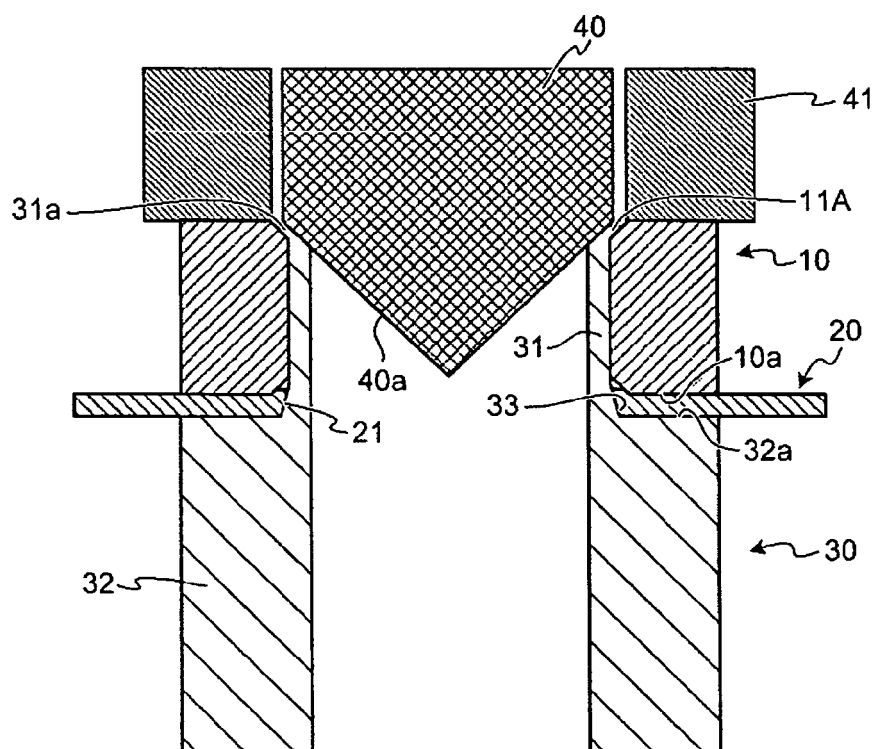


FIG.8

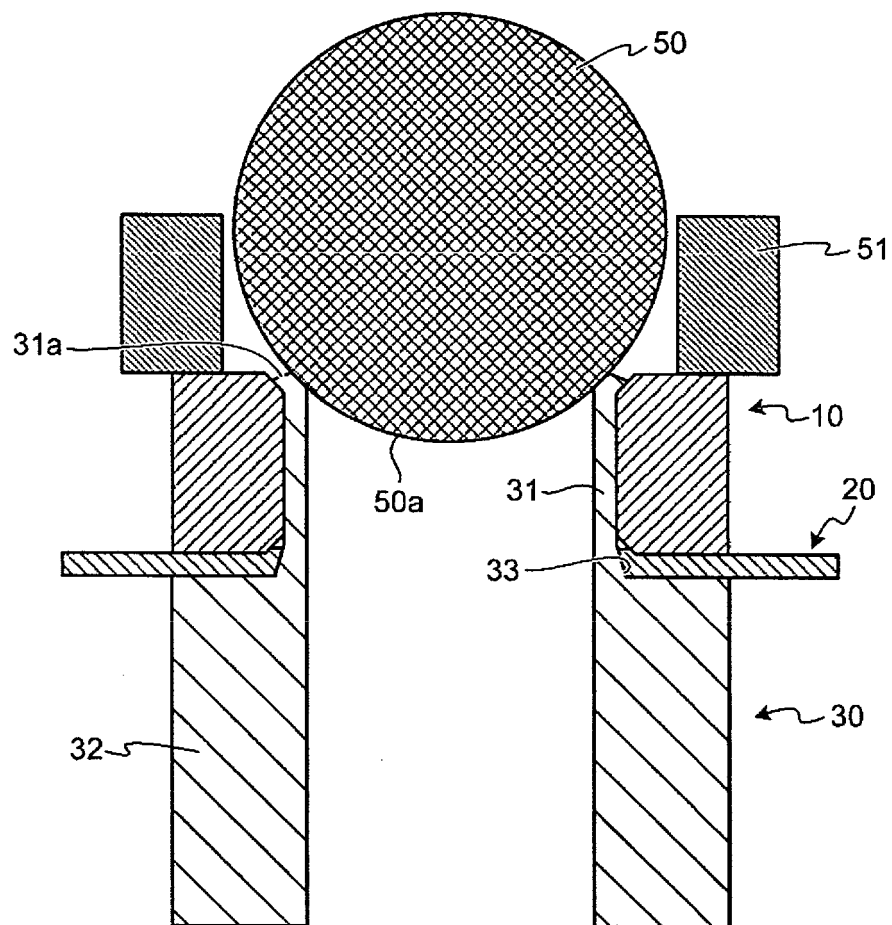


FIG.9

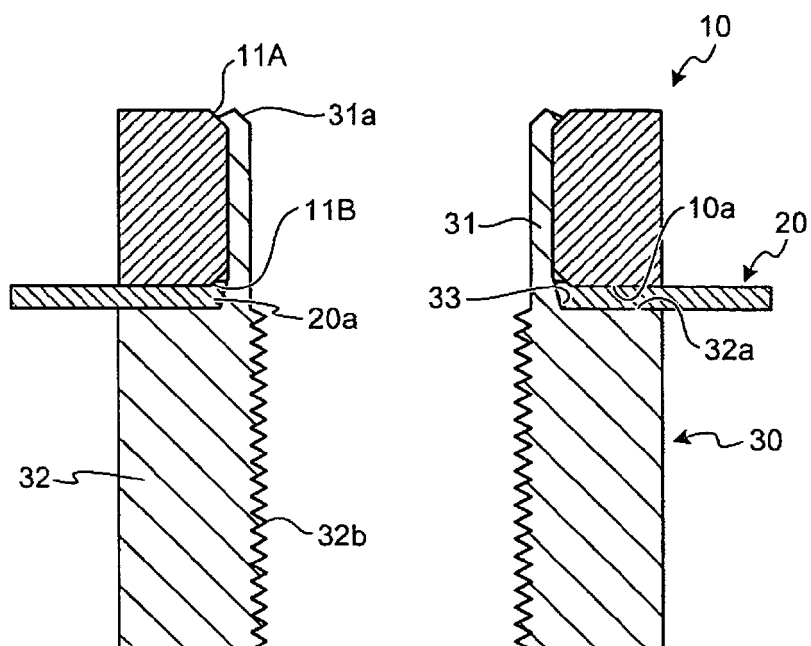


FIG.10

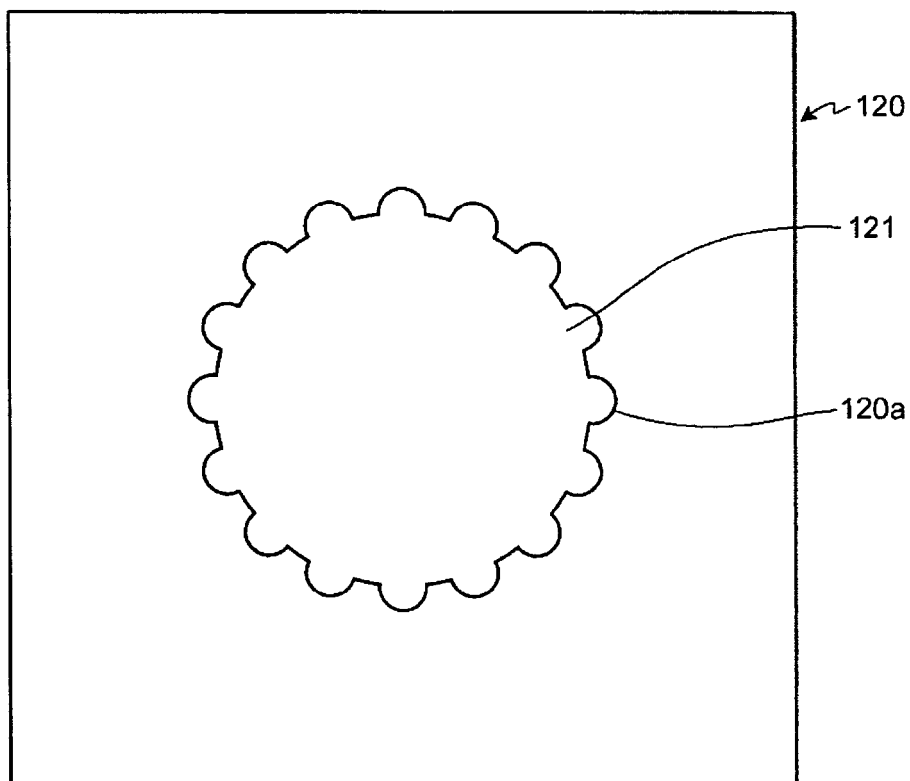


FIG.11

RING CHAMFER SHAPE		TERMINAL		SUBSTRATE HOLE			ROTATIONAL RESISTANCE TORQUE (FIXING STRENGTH)	SUBSTRATE SURFACE PRESSURE STABILITY (ADHESIVENESS)
ANGLE	DEPTH	GRADIENT ANGLE	GRADIENT DEPTH	DIAMETER OF PREPARED HOLE	DIAMETER OF SMALL-DIAMETER HOLES	NUMBER OF SMALL-DIAMETER HOLES		
30°	1.0 mm	10°	1.0 mm	φ 1.5 mm	φ 1.0 mm	32	MODERATE	MODERATE
			1.5 mm			16	HIGH	POOR
						24	HIGH	POOR
						32	HIGH	POOR
			1.0 mm		φ 2.0 mm	16	MODERATE	GOOD
						20	LOW	EXCELLENT
						16	MODERATE	GOOD
						20	LOW	EXCELLENT

FIG.12

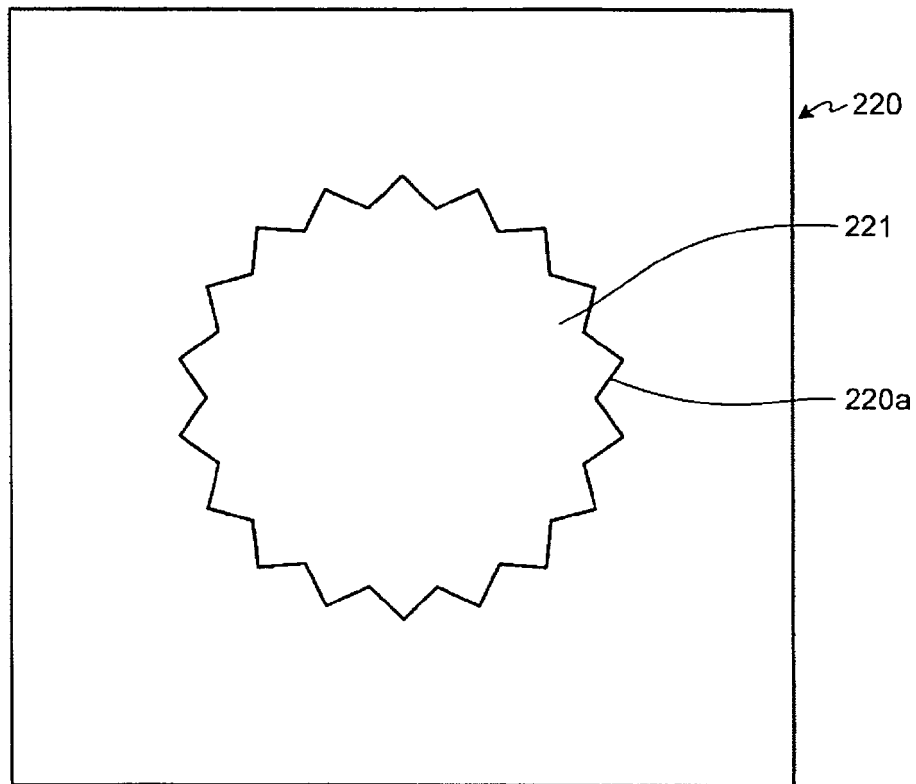


FIG.13

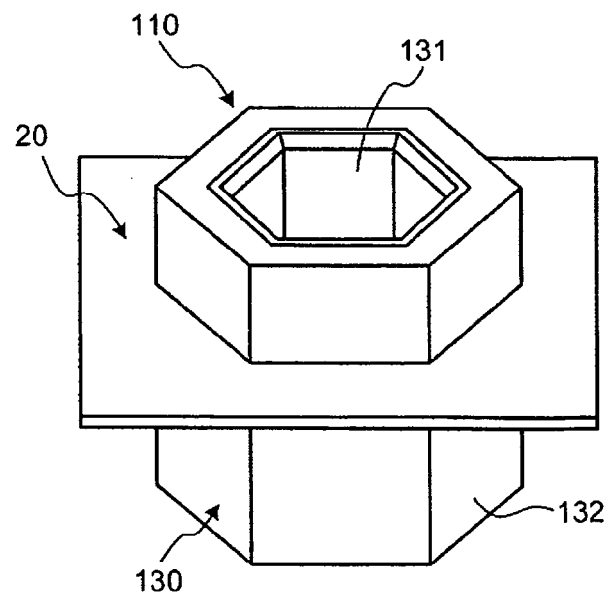
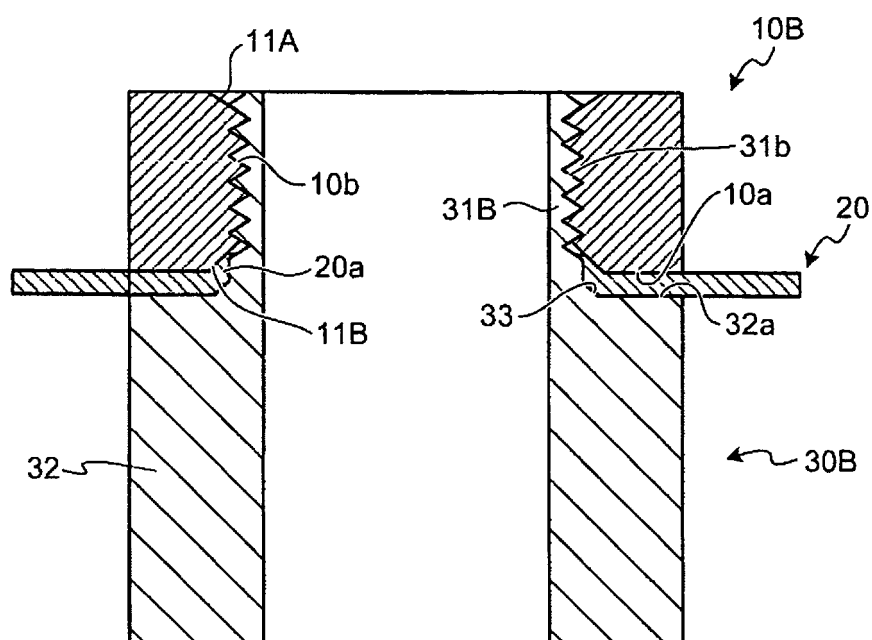


FIG.14



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP H7249882 B [0003]
- US 5365654 A [0004]