



(11) **EP 4 294 119 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
20.12.2023 Bulletin 2023/51

(51) International Patent Classification (IPC):
H05B 3/02 (2006.01)

(21) Application number: **22752839.5**

(52) Cooperative Patent Classification (CPC):
H05B 3/02

(22) Date of filing: **10.02.2022**

(86) International application number:
PCT/JP2022/005469

(87) International publication number:
WO 2022/173017 (18.08.2022 Gazette 2022/33)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Kyocera Corporation**
Kyoto-shi, Kyoto 612-8501 (JP)

(72) Inventor: **MIYOSHI, Haruka**
Kyoto-shi, Kyoto 612-8501 (JP)

(74) Representative: **Viering, Jentschura & Partner mbB**
Patent- und Rechtsanwälte
Am Brauhaus 8
01099 Dresden (DE)

(30) Priority: **12.02.2021 JP 2021021220**

(54) **HEATER**

(57) A heater includes a ceramic body, a heat generating resistor, a conductor, and a bonding material. The ceramic body includes a recessed portion which is open on a surface. The heat generating resistor is located inside the ceramic body. The conductor is electrically connected to the heat generating resistor and located on a bottom surface of the recessed portion. The bonding material bonds the conductor and a lead wire located on the conductor. The bottom surface includes a peripheral edge portion located on the outer side of the opening end of the recessed portion in a plan view. The end portion of the bonding material includes a portion located at the peripheral edge portion.

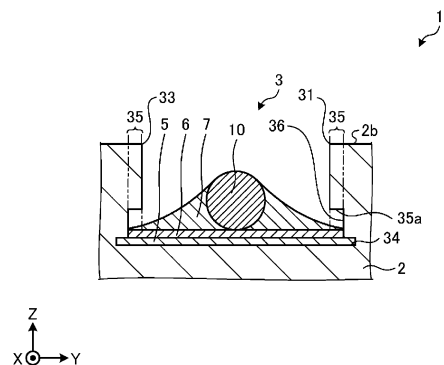


FIG. 3

Description

TECHNICAL FIELD

[0001] An embodiment of the disclosure relates to a heater.

BACKGROUND OF INVENTION

[0002] A known heater includes a heat generating resistor inside a ceramic body. For such a heater, a structure has been proposed in which an opening portion is located at a joint portion between an extraction electrode connected to a heat generating resistor and a lead wire located on the outer side of the ceramic body.

CITATION LIST

PATENT LITERATURE

[0003] Patent Document 1: JP 2011-34979 A

SUMMARY

[0004] A heater according to an aspect of an embodiment includes a ceramic body, a heat generating resistor, a conductor, and a bonding material. The ceramic body includes a recessed portion which is open on a surface. The heat generating resistor is located inside the ceramic body. The conductor is electrically connected to the heat generating resistor and located on the bottom surface of the recessed portion. The bonding material bonds the conductor and the lead wire located on the conductor. The bottom surface includes a peripheral edge portion located on the outer side of the opening end of the recessed portion in a plan view. The end portion of the bonding material includes a portion located at the peripheral edge portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005]

FIG. 1 is a plan view illustrating a heater according to an embodiment.

FIG. 2 is an enlarged view of a region A illustrated in FIG. 1.

FIG. 3 is a cross-sectional view taken along line B-B illustrated in FIG. 2.

FIG. 4 is a cross-sectional view taken along line C-C illustrated in FIG. 2.

FIG. 5 is a horizontal cross-sectional view illustrating a heater according to a first variation of the embodiment.

FIG. 6 is a horizontal cross-sectional view illustrating a heater according to a second variation of the embodiment.

FIG. 7 is a vertical cross-sectional view illustrating a

heater according to a third variation of the embodiment.

FIG. 8 is a horizontal cross-sectional view illustrating a heater according to a fourth variation of the embodiment.

FIG. 9 is a horizontal cross-sectional view illustrating a heater according to a fifth variation of the embodiment.

FIG. 10 is a horizontal cross-sectional view illustrating a heater according to a sixth variation of the embodiment.

FIG. 11 is a plan view illustrating a heater according to a seventh variation of the embodiment.

15 DESCRIPTION OF EMBODIMENTS

[0006] An embodiment of a heater disclosed in the present application will be described below with reference to the accompanying drawings. The present disclosure is not limited by the following embodiment. Note that the drawings are schematic and that the dimensional relationships between elements, the proportions thereof, and the like may differ from the actual ones.

25 Embodiments

[0007] First, a heater according to an embodiment is described with reference to FIG. 1. FIG. 1 is a plan view of the heater according to the embodiment.

[0008] As illustrated in FIG. 1, a heater 1 according to the embodiment includes a ceramic body 2, a heat generating resistor 4, a conductor 5, a bonding material 7, and a lead wire 10. The heater 1 is used for, for example, a hair iron, a soldering iron, and other applications.

[0009] For the sake of clarity of description, FIG. 1 illustrates a three-dimensional orthogonal coordinate system including the Z-axis that extends along a thickness direction of the heater 1. Such an orthogonal coordinate system may also be illustrated in other drawings used in the description below.

[0010] The ceramic body 2 is, for example, a member having a flat plate shape. The ceramic body 2 is made of a material such as an insulating ceramic. Example materials of the ceramic body 2 include an oxide ceramic, a nitride ceramic, a carbide ceramic, and the like. Specifically, an alumina ceramic, a silicon nitride ceramic, an aluminum nitride ceramic, a silicon carbide ceramic, or the like can be used as a material of the ceramic body 2.

[0011] The ceramic body 2 includes a recessed portion 3. The recessed portion 3 is located in contact with an end surface 2a located at one end in the longitudinal direction of the ceramic body 2. The recessed portion 3 is open on a surface 2b of the ceramic body 2 (see FIG. 2). The details of the recessed portion 3 will be described later.

[0012] The heat generating resistor 4 is located inside the ceramic body 2. The heat generating resistor 4 is a member that generates heat when electrical current flows

therethrough. The heat generating resistor 4 may include, for example, a high-resistance conductor containing tungsten, molybdenum, or the like. The shape of the heat generating resistor 4 is not limited to the illustrated shape, and may be appropriately changed in accordance with, for example, heat-generating characteristics required for the heater 1.

[0013] The conductor 5 is electrically connected to the heat generating resistor 4. For example, the conductor 5 is located in contact with both ends of the heat generating resistor 4. The conductor 5 is located overlapping the recessed portion 3 in a plan view. The conductor 5 may be, for example, a metal material containing tungsten, molybdenum, or the like. The conductor 5 may be made of the same material as or a different material from that of the heat generating resistor 4.

[0014] The bonding material 7 is located inside the recessed portion 3. The bonding material 7 bonds the lead wire 10 and the conductor 5. As the bonding material 7, a brazing material such as solder or silver solder can be used, for example.

[0015] The lead wire 10 is a wire containing a metal material such as nickel, iron, or a nickel-based heat-resistant alloy. The cross section of the lead wire 10 may be, for example, circular, elliptical, or rectangular. The outer diameter of the lead wire 10, that is, the equivalent circle diameter of the lead wire 10 in a cross-sectional view may be, for example, from 0.5 to 2.0 mm.

[0016] The heater 1 according to the embodiment is further described with reference to FIGs. 2 to 4. FIG. 2 is an enlarged view of the region A illustrated in FIG. 1. FIG. 3 is a cross-sectional view taken along line B-B illustrated in FIG. 2. FIG. 4 is a cross-sectional view taken along line C-C illustrated in FIG. 2.

[0017] As illustrated in FIGs. 2 and 4, the recessed portion 3 includes a bottom surface 34. An area of the bottom surface 34 is larger than an opening area of the opening end. Here, the opening area of the opening end refers to an area of a region surrounded by an end surface 2a of the ceramic body 2 and ridge lines (opening end) 31 to 33 of the opening of the recessed portion 3 on a surface 2b of the ceramic body 2, when viewed from a direction perpendicular to the surface 2b of the ceramic body 2, as illustrated in FIG. 2.

[0018] Thus, the area of the bottom surface 34 is made to be larger than the opening area of the opening end; whereby the lead wire 10 and the conductor 5 can be more firmly bonded via the bonding material 7. Since the opening area of the opening end is smaller than the area of the bottom surface 34, the proportion of the surface 2b of the ceramic body 2, which functions as a heating surface serving as a main part of the heater 1, increases and performance of the heater improves.

[0019] The bottom surface 34 includes a peripheral edge portion 35. As illustrated in FIG. 2, when viewed from a direction perpendicular to the surface 2b of the ceramic body 2, the peripheral edge portion 35 is located on the outer side of the opening end of the recessed

portion 3. As illustrated in FIG. 3, the recessed portion 3 includes a top surface 35a facing the peripheral edge portion 35. Thus, the recessed portion 3 includes a space sandwiched between the top surface 35a and the peripheral edge portion 35.

[0020] The end portion of the bonding material 7 is located at the peripheral edge portion 35 on the outer side of the opening end of the recessed portion 3 in a plan view. The bonding material 7 extends from the center part of the recessed portion 3 so as to reach the peripheral edge portion 35; thus, the lead wire 10 can be more rigidly fixed. This reduces the possibility of occurrence of damage to the bonding material 7 and the ceramic body 2 caused by, for example, the movement of the lead wire 10, thus reducing a decrease in the performance of the heater 1 over continuous use.

[0021] The peripheral edge portion 35 may be provided on the entire wall surface or part of the wall surface of the recessed portion 3. For example, the peripheral edge portion 35 may be provided at a portion of the recessed portion 3 from which the conductor 5 is drawn out, while the peripheral edge portion 35 need not be provided at a portion of the recessed portion 3 from which the conductor 5 is not drawn out (for example, the rear end of the heater 1). Accordingly, the performance of the heater can be improved at the portion from which the conductor 5 is drawn out, while the possibility of generation of cracks, which starts from the peripheral edge portion 35 at the portion where the conductor 5 is not drawn out, can be reduced. As a result, heating efficiency can be improved, while increasing durability.

[0022] As illustrated in FIG. 3, the end portion of the bonding material 7 may include a portion located at the peripheral edge portion 35 on both sides in the Y-axis direction, which is a second direction intersecting the X-axis direction, which is a first direction in which the lead wire 10 extends, or may include a portion located at the peripheral edge portion 35 on either one side in the Y-axis direction. When the end portion of the bonding material 7 is partially located at the peripheral edge portion 35 on both sides in the Y-axis direction, a decrease in the performance of the heater 1 over continuous use can further be reduced.

[0023] Furthermore, as illustrated in FIG. 4, the end portion of the bonding material 7 may be in contact with a peripheral wall 36 that faces an end surface 10a of the lead wire 10 and is continuous with the peripheral edge portion 35 of the recessed portion 3. This reduces the possibility of occurrence of damage to the bonding material 7 and the ceramic body 2 caused by, for example, the movement of the lead wire 10, thus reducing a decrease in the performance of the heater 1 over continuous use. In particular, when the heater 1 is used in a vibrating environment, the stress tends to concentrate on the end surface 10a in the longitudinal direction of the lead wire 10. In that case, by bringing the bonding material 7 into contact with the peripheral wall 36 of the recessed portion 3, which faces the end surface 10a of the lead wire 10,

the stress concentration at the boundary between the bonding material 7 and the conductor 5 can be dispersed over the entire heater 1 via the peripheral wall 36. Thus, in the heater 1 with the end portion of the bonding material 7 being in contact with the peripheral wall 36, the stress can be relieved.

[0024] As illustrated in FIGs. 3 and 4, the end portion of the bonding material 7 may be in contact with the peripheral wall 36 of the recessed portion 3 that extends in a direction intersecting the bottom surface 34. Since the end portion of the bonding material 7 is in contact with the peripheral wall 36, the bonding material 7 is surrounded by the ceramic body 2 from above, below, and the sides at the peripheral wall 36; thus, a decrease in the performance of the heater 1 over continuous use can further be reduced. The end portion of the bonding material 7 may be in contact with the peripheral wall 36 over the entire circumference thereof, or the bonding material 7 may be in contact with part of the peripheral wall 36. In particular, since the end portion of the bonding material 7 is in contact with the peripheral wall 36 of the recessed portion 3 that faces the end surface 10a of the lead wire 10, the stress concentration occurs not at the boundary between the bonding material 7 and the conductor 5, but at the boundary between the bonding material 7 and the ceramic body 2. Thus, the presence of the end portion of the bonding material 7 at the peripheral edge portion 35 reduces the possibility of occurrence of damage such as microcracks at the boundary between the bonding material 7 and the conductor 5, and thus reduces the possibility of a drop of electric resistance of the conductor 5 even after long-term use.

[0025] As illustrated in FIGs. 3 and 4, the heater 1 may include a plating material 6 that covers the surface of the conductor 5. As the plating material 6, for example, a plating material containing nickel, chromium, or the like can be used. Disposing the plating material 6 between the conductor 5 and the bonding material 7, for example, can improve adhesion with the bonding material 7 and can further reduce a decrease in the performance of the heater 1 over continuous use. The bonding material 7 may be directly located on the bottom surface 34 of the recessed portion 3 without the conductor 5 and the plating material 6 disposed thereon. When the bonding material 7 is located on the bottom surface 34, the possibility of, for example, separation of the bonding material 7. This can reduce a decrease in performance due to the separation of the bonding material 7.

[0026] The plating material 6 may be located at the peripheral edge portion 35 together with the conductor 5. This further restricts the movement of, for example, the lead wire 10, and thus reduces the possibility of occurrence of damage to the bonding material 7 and the ceramic body 2. Thus, a decrease in the performance of the heater 1 over continuous use can further be reduced. The conductor 5 located at the peripheral edge portion 35 may be entirely covered with the plating material 6, or may be partially exposed from the plating material 6.

First Variation

[0027] Variations of the embodiment will be described with reference to FIGs. 5 to 11. In the variations described below, the same components as those in the embodiment are denoted by the same reference numerals, and redundant description may be omitted.

[0028] FIG. 5 is a horizontal cross-sectional view illustrating a heater according to a first variation of the embodiment. As illustrated in FIG. 5, the end portion of the bonding material 7 may be located in contact with the top surface 35a facing the peripheral edge portion 35 of the recessed portion 3. When the end portion of the bonding material 7 is in contact with the top surface 35a, the bonding material 7 is sandwiched between the top surface 35a and the peripheral edge portion 35 at the peripheral edge portion 35. Thus, the end portion of the bonding material 7 is sandwiched by the ceramic body 2, so that the possibility of separation of the bonding material 7 is reduced. This can reduce a decrease in performance due to the separation of the bonding material 7.

Second Variation

[0029] FIG. 6 is a horizontal cross-sectional view illustrating a heater according to a second variation of the embodiment. As illustrated in FIG. 6, the heater 1 is different from the heater 1 illustrated in FIG. 5 in that a protruding portion 35b protruding from the top surface 35a toward the bottom surface 34 side is provided. In addition, the end portion of the bonding material 7 may be located so as to engage with the protruding portion 35b. When the end portion of the bonding material 7 that is in contact with the top surface 35a engages with the protruding portion 35b, the possibility of, for example, separation of the bonding material 7 is reduced. This can further reduce a decrease in performance due to the separation of the bonding material 7.

Third Variation

[0030] FIG. 7 is a vertical cross-sectional view illustrating a heater according to a third variation of the embodiment. As illustrated in FIG. 7, the heater 1 differs from the heater 1 illustrated in FIG. 4 in that the end portion of the bonding material 7 is located away from the peripheral wall 36 facing the end surface 10a of the lead wire 10.

[0031] During assembly of the heater 1, a twisting stress may be applied to the base portion of the lead wire 10 by, for example, bending the lead wire 10. In that case, for example, the end portion of the bonding material 7 is located at the peripheral edge portion 35 on both sides in the second direction intersecting the first direction in which the lead wire 10 extends, as illustrated in FIG. 3. On the other hand, the end portion of the bonding material 7 is located away from the peripheral wall 36 of the recessed portion 3 that faces the end surface 10a of the

lead wire 10, as illustrated in FIG. 7. This allows withstanding of the twisting stress. Thus, in the heater 1 according to the present variation, a decrease in performance over continuous use can further be reduced.

Fourth Variation

[0032] FIG. 8 is a horizontal cross-sectional view illustrating a heater according to a fourth variation of the embodiment. As illustrated in FIG. 8, the heater 1 may include the ceramic body 2 composed of a laminate of a plurality of ceramic materials.

[0033] The ceramic body 2 of the heater 1 illustrated in FIG. 8 includes a first member 21, a second member 22, and a third member 23. The first member 21 and the third member 23 may be, for example, plate-like members having a predetermined shape. The second member 22 located between the first member 21 and the third member 23 may be, for example, a bonding material that bonds the first member 21 and the third member 23.

[0034] When the second member 22 is not located between the third member 23 and the first member 21, the surface of the first member 21 functions as the bottom surface 34. When the second member 22 is not provided between the first member 21 and the third member 23, the surface of the third member 23 functions as the top surface 35a. The compositions of the first member 21, the second member 22, and the third member 23 may be the same or different. The layered structure of the ceramic body 2 is not limited to the one illustrated in the drawing. The ceramic body 2 may be, for example, a laminate of two materials or four or more materials.

Fifth Variation

[0035] FIG. 9 is a horizontal cross-sectional view illustrating a heater according to a fifth variation of the embodiment. As illustrated in FIG. 9, the heater 1 may further include an intermediate layer 8. The heater 1 illustrated in FIG. 9 is different from the heater 1 illustrated in FIG. 4 in that the intermediate layer 8 is provided between the conductor 5 and the plating material 6. The intermediate layer 8 contains at least one of metal elements contained in the conductor 5 and the plating material 6. The intermediate layer 8 may be, for example, a mutual diffusion layer generated by a reaction between the conductor 5 and the plating material 6 during the firing of the heater material.

[0036] The intermediate layer 8 may be located at the peripheral edge portion 35 together with the conductor 5 and the plating material 6. With the intermediate layer 8, the plating material 6 and the conductor 5 can be firmly bonded via the intermediate layer 8 at, for example, the peripheral edge portion 35. Even when a load is applied to the lead wire 10, for example, damage such as micro-cracks is less likely to occur at the end portion of the bonding material 7 and the conductor 5, where stress is likely to concentrate, and thus the electrical resistance

of the conductor 5 is less likely to decrease even after long-term use. Thus, in the heater 1 according to the present variation, a decrease in performance over continuous use can further be reduced.

Sixth Variation

[0037] FIG. 10 is a horizontal cross-sectional view illustrating a heater according to a sixth variation of the embodiment. As illustrated in FIG. 10, the heater 1 may further include a resin material 40. The resin material 40 may be made of, for example, a thermosetting resin, a photo-curable resin, or other curable resins.

[0038] The resin material 40 is located inside the recessed portion 3 so as to cover the lead wire 10 and the bonding material 7. This further restricts the movement of, for example, the lead wire 10, and thus reduces the possibility of occurrence of damage to the bonding material 7 and the ceramic body 2. Thus, a decrease in the performance of the heater 1 over continuous use can further be reduced.

[0039] In addition, the end portion of the resin material 40 may be located at the peripheral edge portion 35 and may further face the peripheral wall 36. This further restricts the movement of, for example, the lead wire 10, decreasing the possibility of occurrence of damage to the bonding material 7 and the ceramic body 2. Thus, a decrease in the performance of the heater 1 over continuous use can further be reduced.

Seventh Variation

[0040] The heater 1 described in the above embodiment and variations includes the recessed portion 3 having a substantially rectangular shape in a plan view, but the shape of the recessed portion 3 is not limited thereto. FIG. 11 is a plan view illustrating a heater according to a seventh variation of the embodiment.

[0041] The recessed portion 3 of the heater 1 illustrated in FIG. 11 includes a first portion 37, a second portion 38, and a third portion 39 in this order from the end surface 2a side of the ceramic body 2. The dimensions in the Y-axis direction of the first portion 37 and the third portion 39 are smaller than that of the second portion 38 located between the first portion 37 and the third portion 39. The use of the ceramic body 2 including such a recessed portion 3 improves the assembling accuracy of, for example, the lead wire 10. The shape of the recessed portion 3 is not limited to the illustrated shape. For example, the recessed portion 3 may include the first portion 37 and the second portion 38, or may include the second portion 38 and the third portion 39.

[0042] Although the embodiment and variations of the present disclosure have been described above, the present disclosure is not limited to those described above, and various changes can be made without departing from the spirit thereof. For example, the intermediate layer 8 illustrated in FIG. 9 and/or the resin material

40 illustrated in FIG. 10 may be applied to the heater 1 of other variations. Furthermore, other components of the above-described embodiment and variations can also be appropriately combined as long as no contradiction occurs.

[0043] As described above, the heater 1 according to the embodiment includes the ceramic body 2, the heat generating resistor 4, the conductor 5, and the bonding material 7. The ceramic body 2 includes the recessed portion 3 which is open on the surface 2b. The heat generating resistor 4 is located inside the ceramic body 2. The conductor 5 is electrically connected to the heat generating resistor 4 and is located on the bottom surface 34 of the recessed portion 3. The bonding material 7 bonds the conductor 5 and the lead wire 10 located on the conductor 5. The bottom surface 34 includes the peripheral edge portion 35 located on the outer side of the opening end of the recessed portion 3 in a plan view. The end portion of the bonding material 7 includes a portion located at the peripheral edge portion 35. This can reduce a decrease in performance over continuous use.

[0044] The heater 1 according to the embodiment also includes the plating material 6 covering the surface of the conductor 5. The conductor 5 and the plating material 6 are located at the peripheral edge portion 35. This can further reduce a decrease in performance over continuous use.

[0045] The heater 1 according to the embodiment includes the intermediate layer 8 located between the conductor 5 and the plating material 6 and contains at least one of metal elements contained in the conductor 5 and the plating material 6. The intermediate layer 8 is located at the peripheral edge portion 35. This can further reduce a decrease in performance over continuous use.

[0046] The end portion of the bonding material 7 according to the embodiment is in contact with the peripheral wall 36 that is continuous with the peripheral edge portion 35. This can further reduce a decrease in performance over continuous use.

[0047] The end portion of the bonding material 7 according to the embodiment is in contact with the top surface 35a that is further continuous with the peripheral wall 36 continuous with the peripheral edge portion 35, and faces the peripheral edge portion 35. This can further reduce a decrease in performance over continuous use.

[0048] The end portion of the bonding material 7 according to the embodiment is located at the peripheral edge portion 35 located in the second direction intersecting the first direction in which the lead wire 10 extends. This can reduce a decrease in performance over continuous use.

[0049] The end portion of the bonding material 7 according to the embodiment is located at the peripheral edge portion 35 on both sides in the second direction intersecting the first direction in which the lead wire 10 extends. This can further reduce a decrease in performance over continuous use.

[0050] The end portion of the bonding material 7 ac-

cording to the embodiment is in contact with the peripheral wall 36 facing the end surface 10a of the lead wire 10 and being continuous with the peripheral edge portion 35. This can reduce a decrease in performance over continuous use.

[0051] The end portion of the bonding material 7 according to the embodiment is located at the peripheral edge portion 35 on both sides in the second direction intersecting the first direction in which the lead wire 10 extends, and is located away from the peripheral wall 36 that faces the end surface 10a of the lead wire 10 and is continuous with the peripheral edge portion 35. This allows the lead wire 10 to withstand the twisting stress when it is applied to the base portion of the lead wire 10. This results in reduction of a decrease in performance over continuous use.

[0052] The heater 1 according to the embodiment further includes the resin material 40 covering the lead wire 10 and the bonding material 7. The end portion of the resin material 40 is located at the peripheral edge portion 35. This can further reduce a decrease in performance over continuous use.

[0053] Additional effects and other aspects can be easily derived by a person skilled in the art. Thus, a wide variety of aspects of the present disclosure are not limited to the specific details and a representative embodiment represented and described above. Accordingly, various changes are possible without departing from the spirit or scope of the general inventive concepts defined by the appended claims and their equivalents.

REFERENCE SIGNS

[0054]

- 1 Heater
- 2 Ceramic body
- 3 Recessed portion
- 4 Heat generating resistor
- 5 Conductor
- 6 Plating material
- 7 Bonding material
- 8 Intermediate layer
- 10 Lead wire
- 34 Bottom surface
- 35 Peripheral edge portion
- 36 Peripheral wall
- 40 Resin material

Claims

1. A heater comprising:

- a ceramic body comprising a recessed portion that is open on a surface of the ceramic body;
- a heat generating resistor located inside the ceramic body;

- a conductor electrically connected to the heat generating resistor and located on a bottom surface of the recessed portion; and
a bonding material that bonds the conductor and a lead wire located on the conductor, wherein the bottom surface comprises a peripheral edge portion located on an outer side of an opening end of the recessed portion in a plan view, and an end portion of the bonding material comprises a portion located at the peripheral edge portion.
2. The heater according to claim 1, further comprising:
a plating material covering a surface of the conductor, wherein the conductor and the plating material are located at the peripheral edge portion.
3. The heater according to claim 2, further comprising:
an intermediate layer located between the conductor and the plating material and containing at least one of metal elements contained in the conductor and the plating material, wherein the intermediate layer is located at the peripheral edge portion.
4. The heater according to any one of claims 1 to 3, wherein the end portion of the bonding material is in contact with a peripheral wall continuous with the peripheral edge portion.
5. The heater according to any one of claims 1 to 4, wherein the end portion of the bonding material is in contact with a top surface that is further continuous with the peripheral wall continuous with the peripheral edge portion and faces the peripheral edge portion.
6. The heater according to any one of claims 1 to 5, wherein the end portion of the bonding material is located at the peripheral edge portion in a second direction intersecting a first direction in which the lead wire extends.
7. The heater according to any one of claims 1 to 5, wherein the end portion of the bonding material is located at the peripheral edge portion on both sides in a second direction intersecting a first direction in which the lead wire extends.
8. The heater according to claim 6 or 7, wherein the end portion of the bonding material is in contact with the peripheral wall facing an end surface of the lead wire and being continuous with the peripheral edge portion.
9. The heater according to claim 7, wherein the end portion of the bonding material is located away from the peripheral wall facing an end surface of the lead wire and being continuous with the peripheral edge portion.
10. The heater according to any one of claims 1 to 9, further comprising:
a resin material covering the lead wire and the bonding material, wherein an end portion of the resin material is located at the peripheral edge portion.

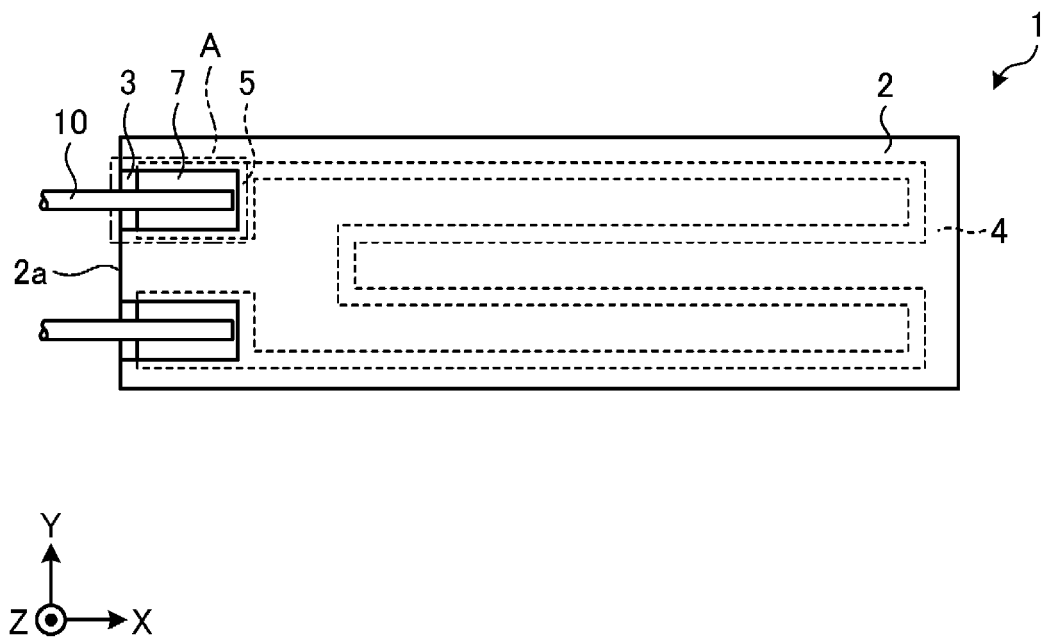


FIG. 1

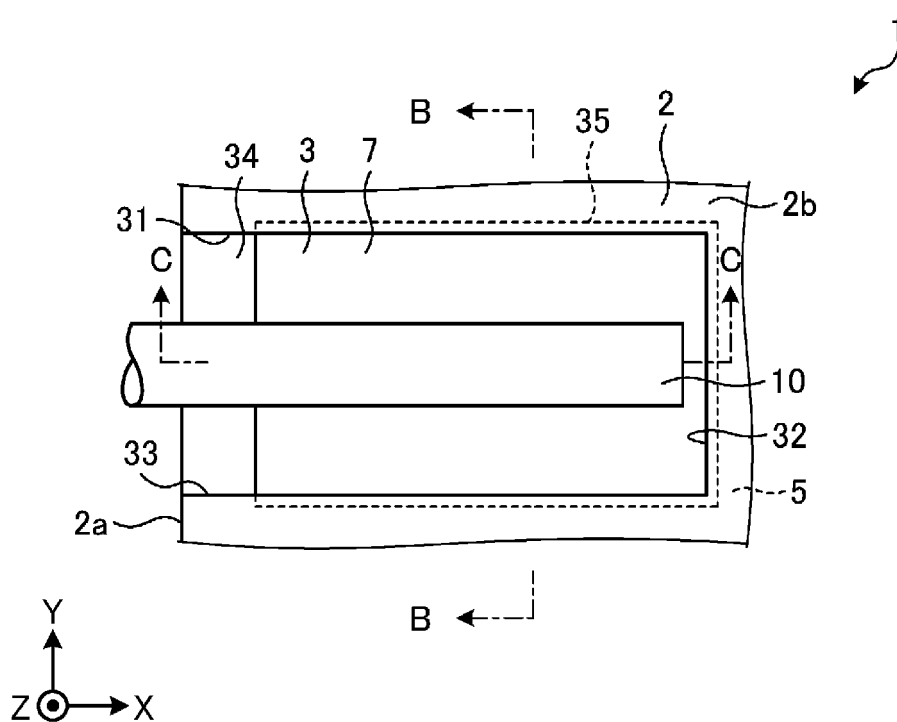


FIG. 2

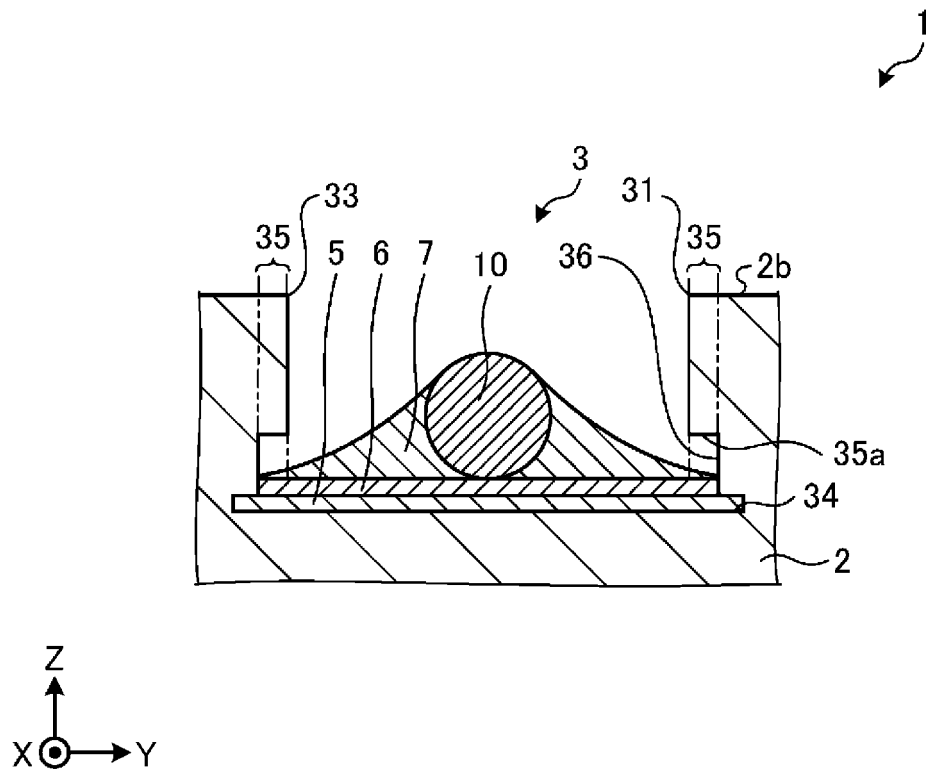


FIG. 3

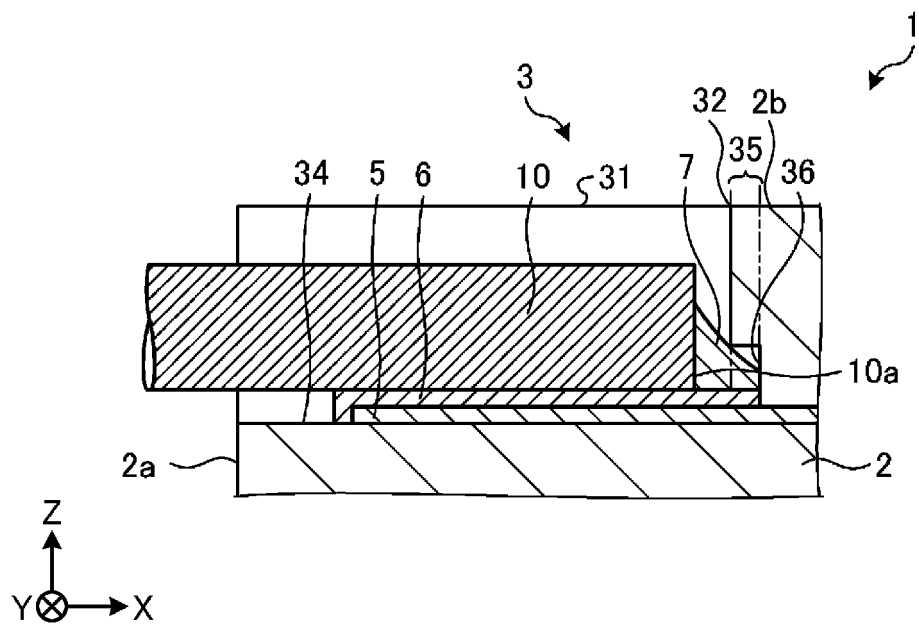


FIG. 4

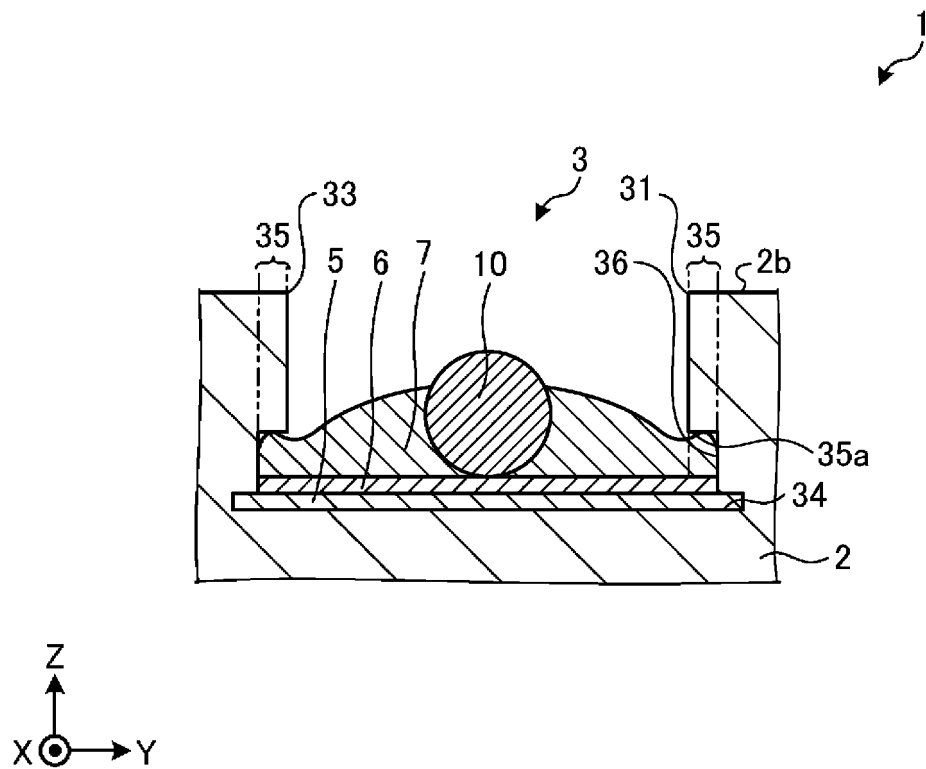


FIG. 5

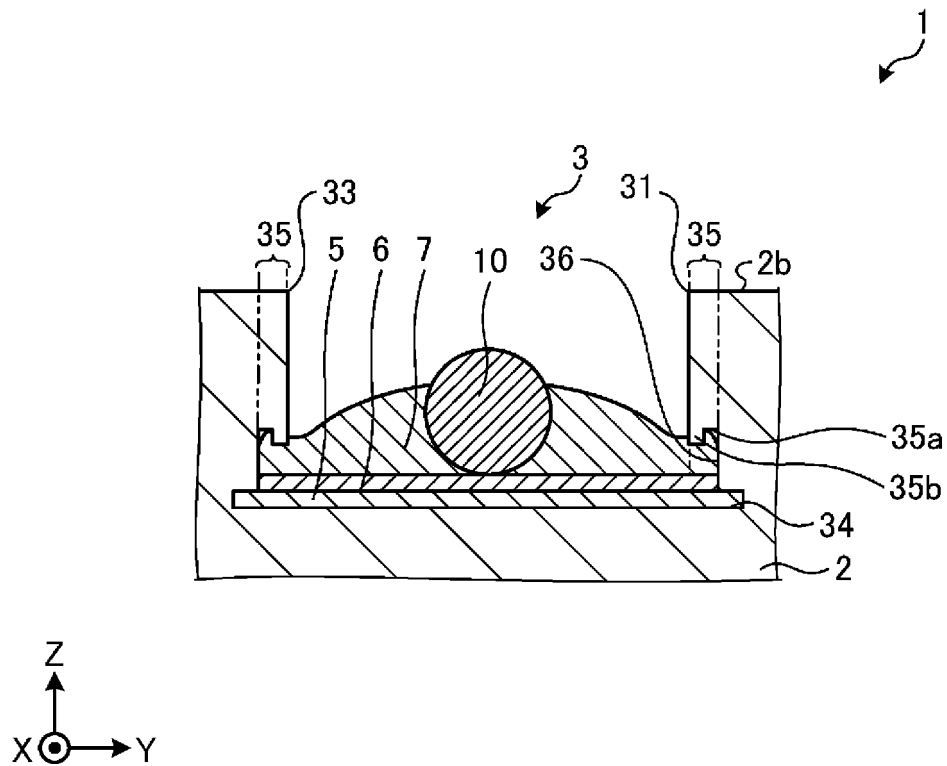


FIG. 6

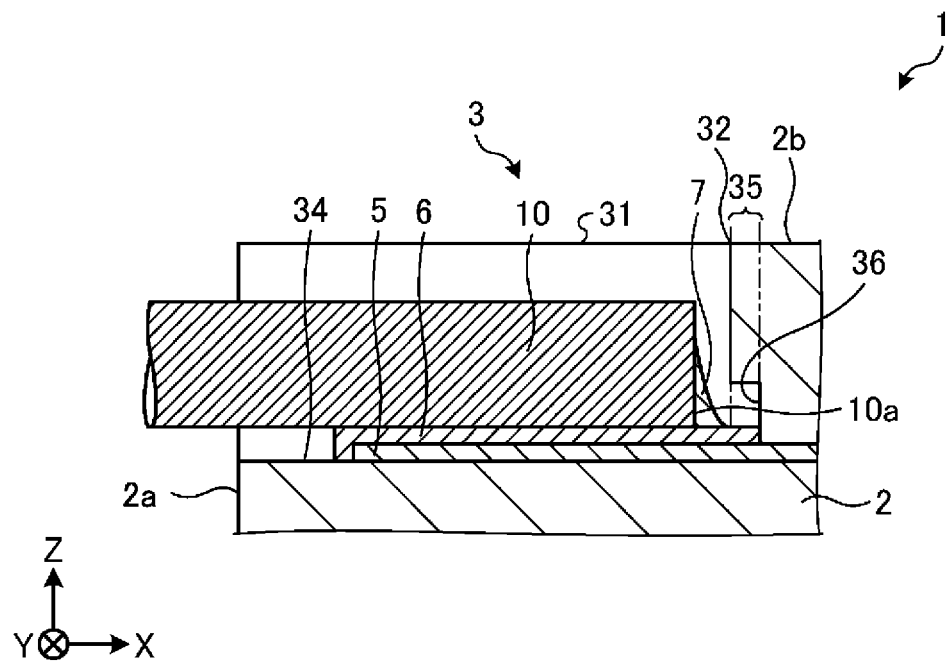


FIG. 7

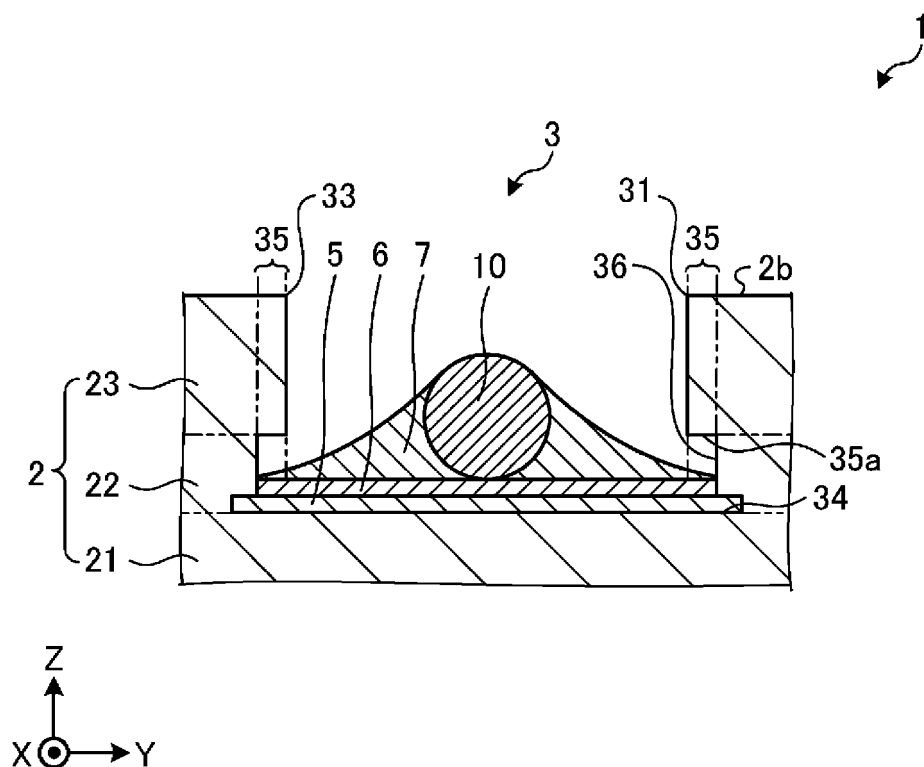


FIG. 8

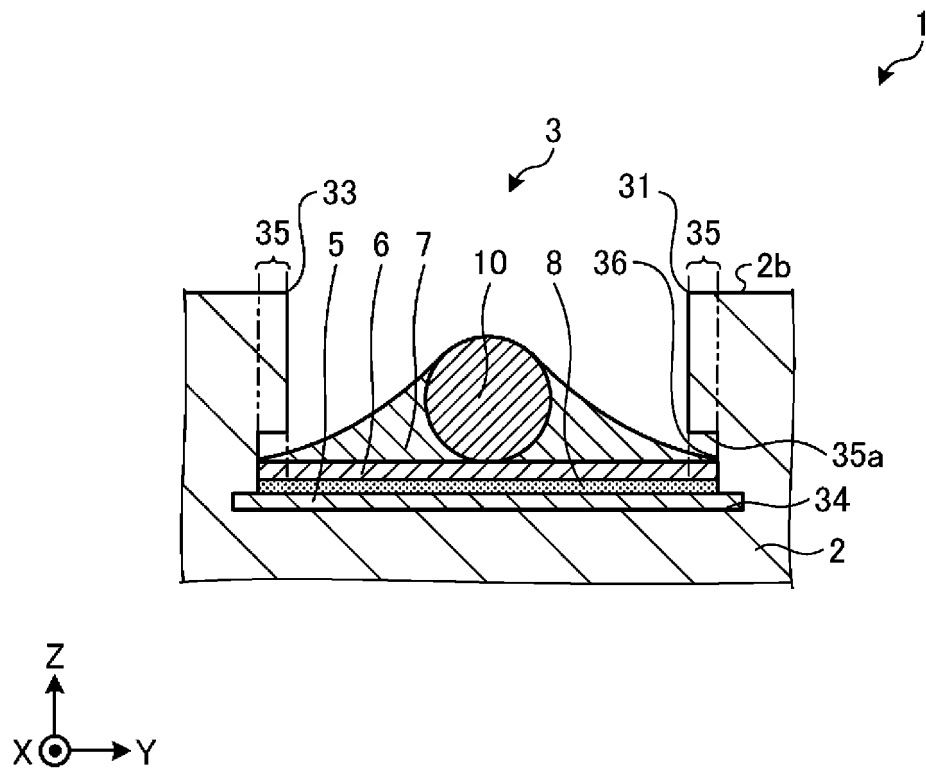


FIG. 9

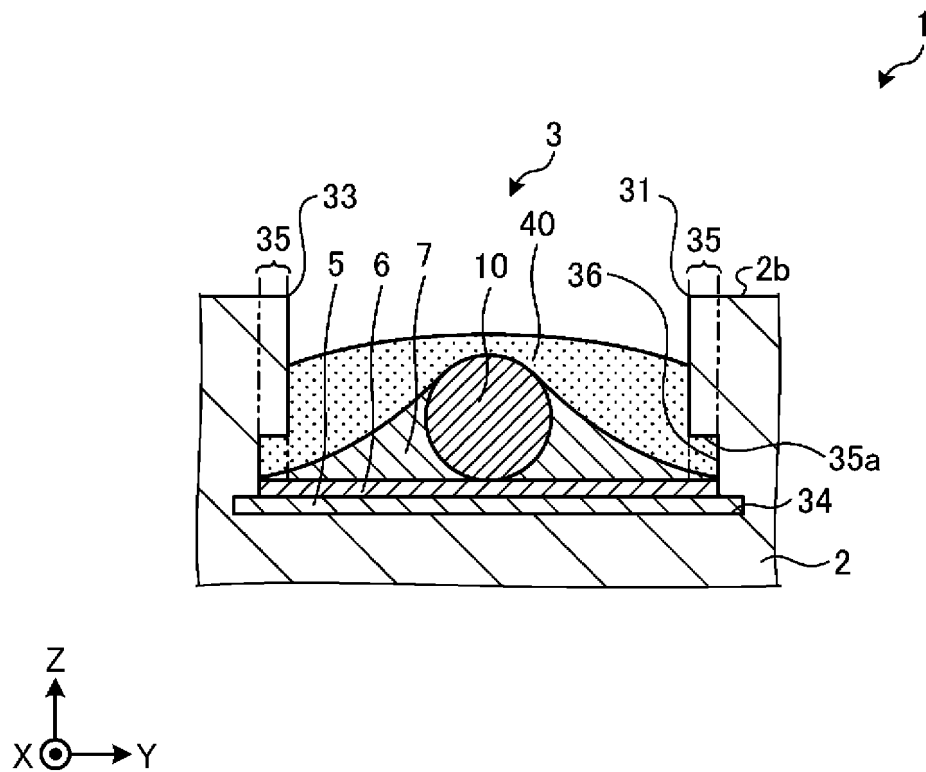


FIG. 10

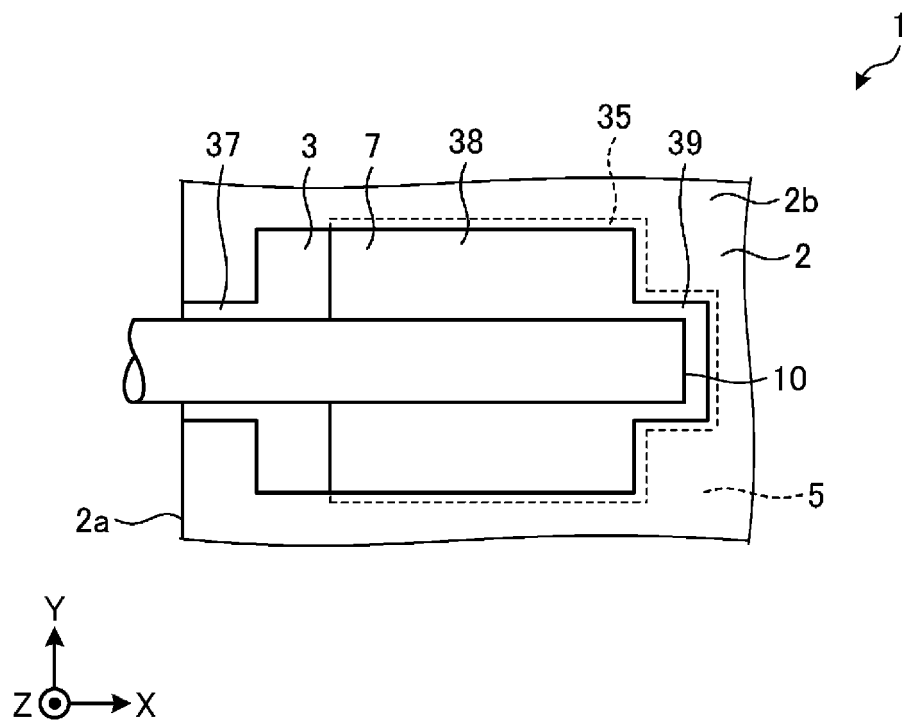


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/005469

A. CLASSIFICATION OF SUBJECT MATTER H05B 3/02 (2006.01)i FI: H05B3/02 A According to International Patent Classification (IPC) or to both national classification and IPC	B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) H05B3/02 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2022 Registered utility model specifications of Japan 1996-2022 Published registered utility model applications of Japan 1994-2022 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)																	
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>JP 2018-101470 A (KYOCERA CORP.) 28 June 2018 (2018-06-28) paragraphs [0010], [0017], [0022], [0024]-[0026], fig. 4</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>JP 2018-18671 A (KYOCERA CORP.) 01 February 2018 (2018-02-01) paragraphs [0012]-[0014], [0021]-[0039], fig. 1-7</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>JP 4-112476 A (NORITZ CORP.) 14 April 1992 (1992-04-14) page 2, upper left column, line 19 to upper right column, line 20, fig. 1</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>JP 11-219774 A (KYOCERA CORP.) 10 August 1999 (1999-08-10) paragraphs [0036]-[0039], fig. 2</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>JP 2007-22908 A (NGK SPARK PLUG CO., LTD.) 01 February 2007 (2007-02-01) paragraphs [0034]-[0036], fig. 4</td> <td>2-3</td> </tr> </tbody> </table>		Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	A	JP 2018-101470 A (KYOCERA CORP.) 28 June 2018 (2018-06-28) paragraphs [0010], [0017], [0022], [0024]-[0026], fig. 4	1-10	A	JP 2018-18671 A (KYOCERA CORP.) 01 February 2018 (2018-02-01) paragraphs [0012]-[0014], [0021]-[0039], fig. 1-7	1-10	A	JP 4-112476 A (NORITZ CORP.) 14 April 1992 (1992-04-14) page 2, upper left column, line 19 to upper right column, line 20, fig. 1	1-10	A	JP 11-219774 A (KYOCERA CORP.) 10 August 1999 (1999-08-10) paragraphs [0036]-[0039], fig. 2	1-10	A	JP 2007-22908 A (NGK SPARK PLUG CO., LTD.) 01 February 2007 (2007-02-01) paragraphs [0034]-[0036], fig. 4
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																
A	JP 2018-101470 A (KYOCERA CORP.) 28 June 2018 (2018-06-28) paragraphs [0010], [0017], [0022], [0024]-[0026], fig. 4	1-10																
A	JP 2018-18671 A (KYOCERA CORP.) 01 February 2018 (2018-02-01) paragraphs [0012]-[0014], [0021]-[0039], fig. 1-7	1-10																
A	JP 4-112476 A (NORITZ CORP.) 14 April 1992 (1992-04-14) page 2, upper left column, line 19 to upper right column, line 20, fig. 1	1-10																
A	JP 11-219774 A (KYOCERA CORP.) 10 August 1999 (1999-08-10) paragraphs [0036]-[0039], fig. 2	1-10																
A	JP 2007-22908 A (NGK SPARK PLUG CO., LTD.) 01 February 2007 (2007-02-01) paragraphs [0034]-[0036], fig. 4	2-3																
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.	* Special categories of cited documents: “A” document defining the general state of the art which is not considered to be of particular relevance “E” earlier application or patent but published on or after the international filing date “L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) “O” document referring to an oral disclosure, use, exhibition or other means “P” document published prior to the international filing date but later than the priority date claimed “T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art “&” document member of the same patent family																	
Date of the actual completion of the international search 24 March 2022	Date of mailing of the international search report 05 April 2022																	
Name and mailing address of the ISA/JP Japan Patent Office (ISA/JP) 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915 Japan	Authorized officer Telephone No.																	

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/005469

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2018-101470 A	28 June 2018	(Family: none)	
JP 2018-18671 A	01 February 2018	(Family: none)	
JP 4-112476 A	14 April 1992	(Family: none)	
JP 11-219774 A	10 August 1999	(Family: none)	
JP 2007-22908 A	01 February 2007	US 2006/0283849 A1 paragraphs [0044]-[0046], fig. 4 EP 1734788 A2 CN 1882199 A	

Form PCT/ISA/210 (patent family annex) (January 2015)

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 2011034979 A [0003]