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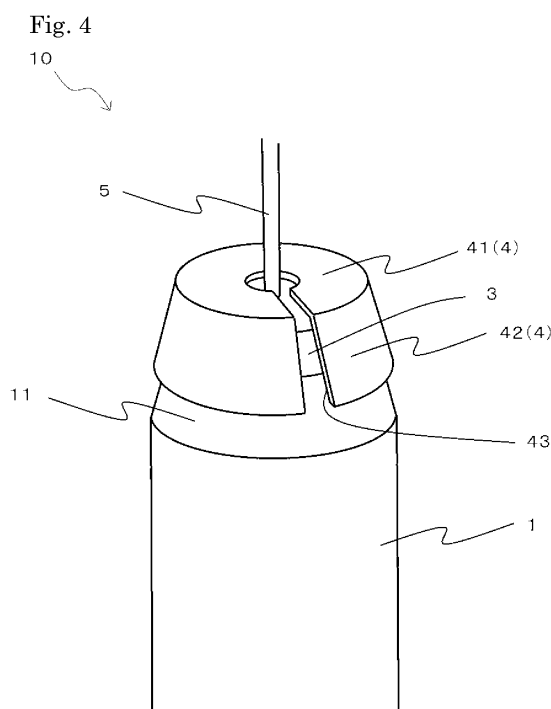
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(54) **HEATER AND GLOW PLUG**

(57) A heater of the present invention includes a rod-shaped ceramic body, a heating resistor embedded in the ceramic body, a conductor layer that is electrically connected to the heating resistor, and a metal cap for external connection, the metal cap covering one end of

the ceramic body together with at least a portion of the conductor layer. The metal cap has a slit in a portion of an outer periphery of the metal cap, the slit extending from an outer region toward an inner region.



Description

Technical Field

[0001] The present invention relates to heaters for use in, for example, combustion vehicle heating systems, kerosene fan heaters, glow plugs for automobile engines, various sensors such as oxygen sensors, or measurement devices. The present invention also relates to glow plugs including the heaters.

Background Art

[0002] An example of heaters for use in combustion vehicle heating systems, kerosene fan heaters, glow plugs for automobile engines, various sensors such as oxygen sensors, or measurement devices is disclosed in, for example, Japanese Unexamined Utility Model Registration Application Publication No. 63-80456 (hereinafter referred to as Patent Document 1). The heater disclosed in Patent Document 1 includes a ceramic body including a heating resistor embedded therein, and a metal cap provided so as to cover an end of the ceramic body. The metal cap is electrically connected to the heating resistor, so that electric power can be supplied to the heating resistor by connecting a lead terminal to the metal cap. Thus, heat can be generated by the heater.

[0003] However, in the heater disclosed in Patent Document 1, thermal stress may be generated between the ceramic body and the metal cap, which are made of different materials. Therefore, there is a problem that it is difficult to improve the long-term reliability of the heater in heat cycles.

[0004] The present invention has been made in light of the above-described problems, and an object of the present invention is to provide a heater in which thermal stress generated between a ceramic body and a metal cap can be reduced.

Summary of Invention

[0005] A heater according to an aspect of the present invention includes a rod-shaped ceramic body; a heating resistor embedded in the ceramic body; a conductor layer on at least a surface of the ceramic body at one end of the ceramic body, the conductor layer being electrically connected to the heating resistor; and a metal cap for external connection, the metal cap covering the one end of the ceramic body together with at least a portion of the conductor layer. The metal cap has a slit in a portion of an outer periphery of the metal cap, the slit extending from an outer region toward an inner region.

Brief Description of Drawings

[0006]

Fig. 1 is a sectional view of a heater and a glow plug

according to an embodiment of the present invention.

Fig. 2 is a perspective view of an end of a ceramic body and a conductor layer included in the heater illustrated in Fig. 1.

Fig. 3 is a perspective view of a metal cap included in the heater illustrated in Fig. 1.

Fig. 4 is an enlarged perspective view of a region around the metal cap in the heater illustrated in Fig. 1.

Fig. 5 is an enlarged sectional view of the region around the metal cap in the heater illustrated in Fig. 1.

Description of Embodiments

[0007] A heater according to an embodiment of the present invention will be described with reference to the drawings. Fig. 1 is a sectional view of a heater 10 according to the embodiment of the present invention. As illustrated in Fig. 1, the heater 10 includes a ceramic body 1, a heating resistor 2 embedded in the ceramic body 1, and a metal cap 4 that covers one end of the ceramic body 1. Although not illustrated in Fig. 1, as illustrated in Fig. 2, a conductor layer 3 is provided on the one end of the ceramic body 1. In Fig. 2, the hatched area shows the region in which the conductor layer 3 is provided. The heating resistor 2 and the conductor layer 3 are electrically connected to each other by a lead portion 22.

[0008] The ceramic body 1 is, for example, a rod-shaped component. Herein, a rod-shaped object is defined as an object that is long in a certain direction. Therefore, a plate-shaped object that is long in a certain direction may also be regarded as being rod-shaped. The ceramic body 1 has a tapered portion 11 at the one end thereof. The ceramic body 1 may be made of, for example, electrically insulating ceramics, such as oxide ceramics, nitride ceramics, or carbide ceramics. More specifically, alumina ceramics, silicon nitride ceramics, aluminum nitride ceramics, silicon carbide ceramics, etc., may be used. In particular, the ceramic body 1 is preferably made of a silicon nitride ceramic. Silicon nitride ceramics are advantageous in that silicon nitride, which is the main component, is strong, tough, highly insulative, and highly resistant to heat.

[0009] The ceramic body 1 made of a silicon nitride ceramic may be obtained by, for example, mixing silicon nitride, which is the main component, with 5 to 15 mass% of a rare earth element oxide, such as Y_2O_3 , Yb_2O_3 , or Er_2O_3 , which serves as a sintering additive, 0.5 to 5 mass% of Al_2O_3 , and SiO_2 so that the content of SiO_2 in the sintered body is 1.5 to 5 mass%; forming the mixture into a predetermined shape; and performing hot-press firing at 1650°C to 1780°C. In the case where the ceramic body 1 is rod-shaped, the length of the ceramic body 1 is set to, for example, 20 to 50 mm, and the diameter of the ceramic body 1 is set to, for example, 2.5 to 5 mm. When the length of the ceramic body 1 is about 20 to 50 mm and the diameter of the ceramic body 1 is about 3 mm, the length of the tapered portion 11 may be set to

0.1 to 3 mm, and the diameter of the end surface of the tapered portion 11 may be set to 1 to 2.9 mm.

[0010] When the ceramic body 1 is made of a silicon nitride ceramic and the heating resistor 2 is made of molybdenum (Mo) or tungsten (W), MoSi_2 or WSi_2 , for example, is preferably mixed and dispersed in the ceramic body 1. In this case, the coefficient of thermal expansion of the silicon nitride ceramic, which is the base material, can be set to a value close to the coefficient of thermal expansion of the heating resistor 2, and the durability of the heater 10 can be increased.

[0011] The heating resistor 2 is a resistor for generating heat, and generates heat when a current flows there-through. The heating resistor 2 is embedded in the ceramic body 1. The heating resistor 2 includes a heating portion 21, which is a portion that mainly generates heat, and lead portions 22 that are connected to the heating portion 21. The heating portion 21 of the heating resistor 2 is provided at the other end of the ceramic body 1. The heating portion 21 has a folded shape, and both ends thereof are connected to the lead portions 22. The heating portion 21 having the folded shape generates a maximum amount of heat in a central region of the folded portion. The distance from the front end of the heating portion 21 to the rear end of the heating resistor 2 in the length direction of the ceramic body 1 is set to, for example, 2 to 10 mm.

[0012] The lead portions 22 are components for electrically connecting the heating portion 21 to an external power supply. One end of each lead portion 22 extends to a surface of the ceramic body 1, and the other end is connected to the heating portion 21. The lead portions 22 are separately connected to both ends of the heating portion 21. One of the lead portions 22 extends to an end surface of the ceramic body 1 at the one end thereof. In Fig. 2, the location at which the lead portion 22 extends to the end surface of the ceramic body 1 at the one end thereof is shown by the broken line. The other lead portion 22 extends to an outer peripheral surface of the ceramic body 1 in a region near the one end thereof.

[0013] The heating resistor 2 may be made of a material having, for example, a carbide, nitride, or silicide of W, Mo, titanium (Ti) or the like as the main component. The heating resistor 2 may contain the same material as the material of the ceramic body 1, so that the ceramic body 1 and the heating resistor 2 have coefficients of thermal expansion that are close to each other. The heating portion 21 has a high resistance, and generates a maximum amount of heat in a region around the folded portion. The resistance per unit length of the lead portions 22 is set to a value smaller than that of the heating portion 21 by, for example, making the content of the material of the ceramic body 1 in the lead portions 22 smaller than that in the heating portion 21, or making the cross section of the lead portions 22 larger than that of the heating portion 21.

[0014] The conductor layer 3 is a component for electrically connecting the heating resistor 2 to an external

electrode. The conductor layer 3 is provided on the one end of the ceramic body 1. More specifically, the conductor layer 3 is provided on the end surface of the ceramic body 1 and a portion of the outer peripheral surface of the tapered portion 11. The conductor layer 3 is electrically connected to the heating resistor 2 by the corresponding lead portion 22. The conductor layer 3 includes a metallized layer and a plating layer stacked on the metallized layer. The metallized layer may be, for example, a metallized layer containing silver, copper, and titanium, or a metallized layer containing gold, nickel, and palladium (Pd). The plating layer may be, for example, a nickel boron plating layer, a gold plating layer, or a nickel plating layer. The thickness of the metallized layer may be set to, for example, about 20 to 40 μm . The thickness of the plating layer is preferably greater than or equal to, for example, 1 μm .

[0015] The metal cap 4 is a meal component including a bottom portion 41 and a side portion 42. The metal cap 4 may be made of, for example, a metal material such as a stainless steel or an iron-nickel-cobalt (Fe-Ni-Co) alloy. In particular, from the viewpoint of thermal expansion, an iron-nickel-cobalt (Fe-Ni-Co) alloy is preferably used. The metal cap 4 is a component for strongly connecting the conductor layer 3 to the external electrode. The metal cap 4 is arranged so as to cover the one end of the ceramic body 1 and at least a portion of the conductor layer 3, and is electrically connected to the conductor layer 3. The metal cap 4 has a shape corresponding to the tapered shape of the ceramic body 1. More specifically, the bottom portion 41 has the shape of a substantially circular plate. The side portion 42 is shaped such that the side portion 42 is substantially annular in cross section perpendicular to the axial length direction of the ceramic body 1, and such that the side portion 42 expands as the distance from the bottom portion 41 increases. The metal cap 4 is attached to the ceramic body 1 such that the bottom portion 41 faces the one end of the ceramic body 1 and the side portion 42 covers part of the tapered portion 11.

[0016] As illustrated in Figs. 3 and 4, the metal cap 4 has a slit 43 formed in a portion of the outer periphery of the metal cap 4. The slit 43 extends from an outer region, that is, the rim, toward an inner region, that is, the central region. More specifically, the slit 43 extends from the bottom edge of the side portion 42 toward the center of the bottom portion 41. Accordingly, when the thermal expansion of the metal cap 4 occurs, the metal cap 4 can be deformed such that the width of the slit 43 decreases. Thus, the difference between the amount of thermal expansion of the metal cap 4 and the amount of thermal expansion of the ceramic body 1 can be reduced. This leads to a reduction in the thermal stress generated between the metal cap 4 and the ceramic body 1. As a result, the long-term reliability of the heater 10 can be improved.

[0017] In addition, as illustrated in Fig. 5, the inclination angle α of the inner peripheral surface of the side portion

42 of the metal cap 4 is greater than the inclination angle β of the tapered portion 11. Herein, the inclination angle α shows how much the inner peripheral surface of the side portion 42 is inclined with respect to the plane including the inner surface of the bottom portion 41. The inclination angle β shows how much the outer peripheral surface of the tapered portion 11 is inclined with respect to a plane perpendicular to the axial direction of the ceramic body 1.

[0018] Since the inclination angle α is greater than the inclination angle β , when the metal cap 4 is attached to the tapered portion 11, the bottom surface of the side portion 42 of the metal cap 4 comes into contact with the tapered portion 11, and a gap can be provided between the inner surface of the bottom portion 41 of the metal cap 4 and a portion of the conductor layer 3 that is provided on the end surface of the tapered portion 11. By placing a solder material 7 in this gap, as illustrated in Fig. 5, the metal cap 4 and the conductor layer 3 can be strongly bonded to each other. The inclination angle α of the inner peripheral surface of the side portion 42 may be set to, for example 40° to 80° . The inclination angle β of the tapered portion 11 may be set to, for example, 45° to 75° . In Figs. 1 and 4, the solder material 7 is omitted to simplify the drawings.

[0019] The metal cap 4 is formed such that the slit 43 extends to the center of the metal cap 4. In other words, the slit 43 extends from the bottom edge of the side portion 42 of the metal cap 4 to the central region of the bottom portion 41. Accordingly, the thermal expansion of the bottom portion 41 in the circumferential direction can be reduced in a balanced manner, so that a change in the shape of the bottom portion 41 after the thermal expansion from that before the thermal expansion can be reduced. Accordingly, the thermal stress generated in the metal cap 4 can be further reduced.

[0020] In the heater 10 according to the present embodiment, the slit 43 is formed such that the slit 43 has a circular-hole-shaped end portion in the central region. A slit having such a shape is also regarded as a single slit 43. The slit 43 may, of course, instead be formed so as to have a constant width to the center of the bottom portion 41, or such that the width thereof changes at an intermediate position.

[0021] With regard to the dimensions of the metal cap 4, when the diameter of the ceramic body 1 is about 3 mm, for example, the inner diameter of the bottom portion 41 may be set to about 1.5 to 2 mm, and the thickness of the bottom portion 41 may be set to about 0.1 to 0.5 mm. In addition, the inner diameter of the side portion 42 at the bottom end thereof may be set to about 1.5 to 2.5 mm, the thickness of the side portion 42 may be set to about 0.1 to 0.5 mm, and the height of the side portion 42 may be set to 1 to 1.2 mm. The length of the slit 43 may be set to 1 to 2 mm.

[0022] The heater 10 further includes a lead terminal 5 having an end portion connected to the conductor layer 3. The lead terminal 5 is a component for electrically con-

necting the metal cap 4 and the conductor layer 3 to the external electrode. The lead terminal 5 is made of, for example, a metal material such as nickel or a stainless steel. The terminal 5 is a linear component, and the end portion thereof is disposed in the slit 43 in the metal cap 4 and bonded to the metal cap 4. Accordingly, the metal cap 4 and the lead terminal 5 can be more strongly bonded together than in the case where the lead terminal 5 is bonded to the outer surface of the bottom portion 41 of the metal cap 4. The above-described solder material 7 spreads over a portion of the slit 43 that is formed in the bottom portion 41, and surrounds the lead terminal 5.

[0023] In the heater 10 illustrated in Fig. 5, the solder material 7 spreads not only in the portion of the slit 43 that is formed in the bottom portion 41 but also to the region outside the bottom portion 41. The portion of the solder material 7 that spreads to the region outside the bottom portion 41 surrounds the end portion of the lead terminal 5. Accordingly, the metal cap 4 and the lead terminal 5 can be more strongly bonded together.

[0024] The width of the end portion of the slit 43 is greater than the width of a portion of the slit 43 that extends from the outer region toward the inner region. More specifically, the end portion of the slit 43 has a circular shape in plan view at the central region of the bottom portion 41 of the metal cap 4, and the diameter (width) of the end portion of the slit 43 is greater than the width of the portion of the slit 43 that extends from the outer region toward the inner region. Accordingly, when the metal cap 4 and the lead terminal 5 are bonded together while the lead terminal 5 is disposed in the end portion of the slit 43, the risk that the lead terminal 5 will be shifted to the portion of the slit 43 that extends from the outer region toward the inner region can be reduced. The lead terminal 5 may have a diameter that is greater than the width of the portion of the slit 43 that extends from the outer region toward the inner region and smaller than the diameter (width) of the end portion of the slit 43. In this case, the risk that the lead terminal 5 will be shifted to the portion of the slit 43 that extends from the outer region toward the inner region can be further reduced.

[0025] Although the end portion of the slit 43 has a circular shape in the present embodiment, the shape of the end portion is not limited to this. More specifically, the end portion of the slit 43 may instead have a polygonal shape, such as a rectangular shape. Alternatively, the end portion of the slit 43 may have, for example, an elliptical shape or an oval shape. When the end portion of the slit 43 has a polygonal shape, the length of the longest one of the diagonal lines that connect the corners may be regarded as the width. When the end portion of the slit 43 has an elliptical shape or an oval shape, the length of the major axis may be regarded as the width.

[0026] The solder material 7 may be applied such that the solder material 7 spreads over the portion of the slit 43 that is formed in the bottom portion 41 but does not spread into a portion of the slit 43 that is formed in the side portion 42. In this case, the metal cap 4 and the lead

terminal 5 can be strongly bonded together while the thermal stress generated between the metal cap 4 and the ceramic body 1 is suppressed.

[0027] The solder material 7 may be applied such that the solder material 7 spreads not only over a portion of the conductor layer 3 provided on the end surface of the ceramic body 1 but also over a portion of the conductor layer 3 provided on a portion of the outer peripheral surface of the tapered portion 11. In addition, the portion of the conductor layer 3 provided on a portion of the outer peripheral surface of the tapered portion 11 may be bonded to the side portion 42 of the metal cap 4. In this case, the metal cap 4 and the lead terminal 5 can be more strongly bonded together.

[0028] The metal cap 4 includes the bottom portion 41 and the side portion 42, and the conductor layer 3 is located on a surface of the ceramic body 1 in a region closer to the bottom portion 41 of the metal cap 4 than the open end of the side portion 42 is. More specifically, the end of the side portion 42 of the metal cap 4 opposite the end at which the bottom portion 41 is provided is in contact with the outer peripheral surface of the tapered portion 11, and the conductor layer 3 is provided on the outer peripheral surface of the tapered portion 11 in a region closer to the end surface of the ceramic body 1 than a portion of the outer peripheral surface of the tapered portion 11 that is in contact with the side portion 42 is. In other words, the conductor layer 3 may be arranged such that the conductor layer 3 is not provided on a portion of the outer peripheral surface of the tapered portion 11 that is in contact with the side portion 42. Accordingly, when the conductor layer 3 and the metal cap 4 are bonded together with the solder material 7, the solder material 7 may be easily introduced into the space between the conductor layer 3 and the metal cap 4.

[0029] As described above, one lead portion 22 of the heating resistor 2 extends to the end surface of the ceramic body 1 at the one end thereof. The region to which the lead portion 22 extends overlaps the slit 43, and the lead terminal 5 is placed in the slit 43. Also, the lead terminal 5 is located so as to overlap the region to which the lead portion 22 extends. Accordingly, the lead portion 22 and the lead terminal 5 may be arranged near each other, so that the length of the path along which the electricity flows between the lead portion 22 and the lead terminal 5 can be reduced. As a result, unnecessary resistance between the lead portion 22 and the lead terminal 5 can be reduced.

[0030] Referring to Fig. 1 again, a glow plug 100 according to the present embodiment includes the above-described heater 10 and a cylindrical metal member 6 attached to the heater 10 at the tapered-portion-11 side of the heater 10.

[0031] The metal member 6 is a component for holding the ceramic body 1. The metal member 6 is a cylindrical component, and is provided so as to surround the one end of the ceramic body 1. In other words, the ceramic body 1 is inserted in the metal member 6. The metal

member 6 is electrically connected to the other lead portion 22 that extends to the region near the one end of the ceramic body 1. The metal member 6 is made of, for example, a stainless steel or an iron-nickel-cobalt (Fe-Ni-Co) alloy.

[0032] The metal member 6 and the ceramic body 1 are bonded together with a solder material (not shown). The solder material is provided so as to surround the end portion of the ceramic body 1. In other word, the solder material is provided in the form of a layer over the entire circumference of the end portion of the ceramic body 1. Accordingly, the metal member 6 and the ceramic body 1 are strongly bonded together.

[0033] The solder material 7 and the solder material with which the metal member 6 and the ceramic body 1 are bonded together may be, for example, silver-copper (Ag-Cu) solder, Ag solder, or Cu solder containing 5 to 30 mass% of glass component. The glow plug 100 according to the present embodiment includes the heater 10 in which the thermal stress generated between the metal cap 4 and the ceramic body 1 is reduced, and therefore the long-term reliability of the heater 10 is increased. As a result, the long-term reliability of the glow plug 100 is increased.

Reference Signs List

[0034]

1	ceramic body
11	tapered portion
2	heating resistor
21	heating portion
22	lead portion
3	conductor layer
4	metal cap
41	bottom portion
42	side portion
43	slit
5	lead terminal
6	metal member
7	solder material
10	heater
100	glow plug

Claims

1. A heater comprising a rod-shaped ceramic body; a heating resistor embedded in the ceramic body; a conductor layer on at least a surface of the ceramic body at one end of the ceramic body, the conductor layer being electrically connected to the heating resistor; and a metal cap for external connection, the metal cap covering the one end of the ceramic body together with at least a portion of the conductor layer, wherein the metal cap has a slit in a portion of an outer periphery of the metal cap, the slit extending

from an outer region toward an inner region.

2. The heater according to Claim 1, wherein an end portion of the slit reaches a center of the metal cap. 5
3. The heater according to Claim 1 or 2, wherein a width of an end portion of the slit is greater than a width of a portion of the slit that extends from the outer region toward the inner region. 10
4. The heater according to any one of Claims 1 to 3, further comprising a lead terminal including an end portion connected to the conductor layer, the end portion of the lead terminal being located in the slit and bonded to the metal cap. 15
5. The heater according to Claim 4, wherein the heating resistor extends to an end surface of the ceramic body at the one end, and a portion of the heating resistor that extends to the end surface overlaps the slit. 20
6. The heater according to any one of Claims 1 to 5, wherein the metal cap includes a bottom portion and a side portion, and the conductor layer is located on a surface of the ceramic body in a region closer to the bottom portion of the metal cap than an open end of the side portion is. 25
7. A glow plug comprising the heater according to any one of Claims 1 to 6, and a cylindrical metal member attached to the heater at the one-end side of the heater. 30

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Fig. 1

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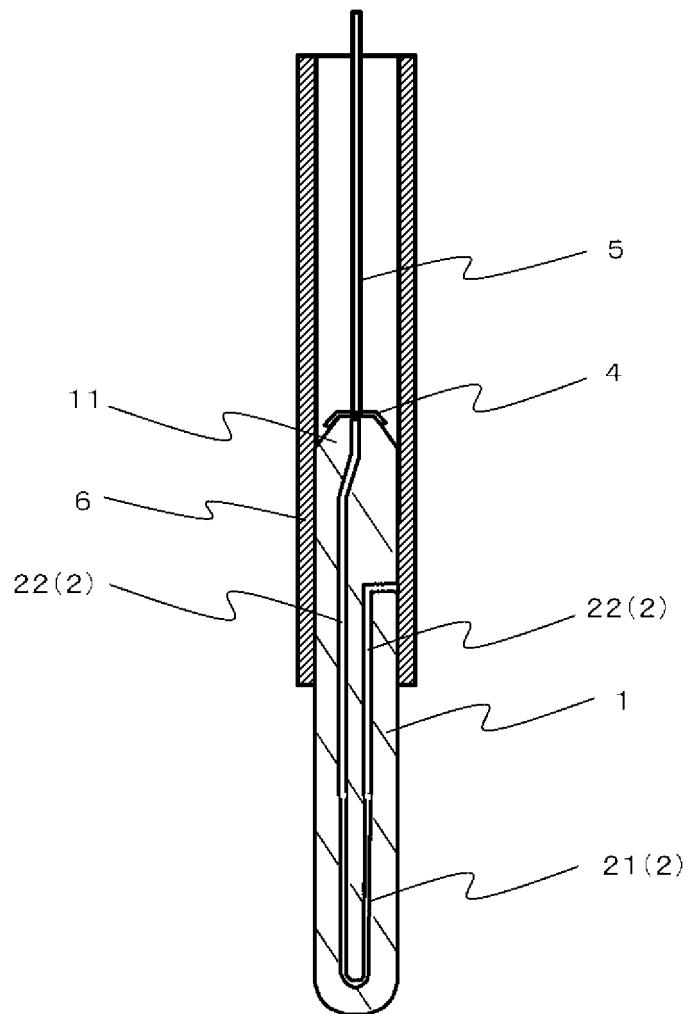


Fig. 2

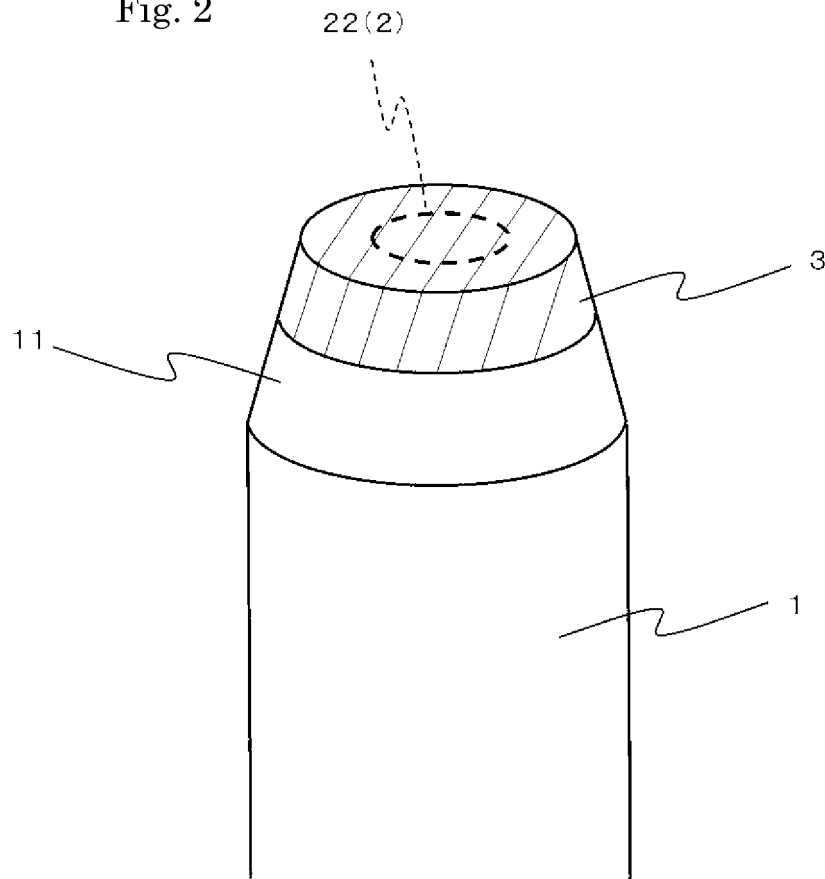


Fig. 3

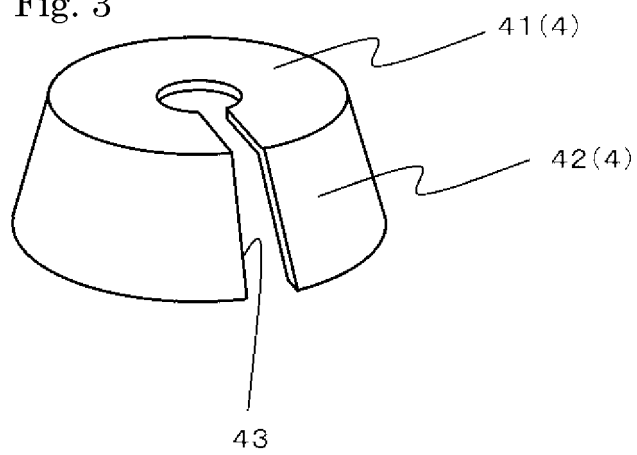


Fig. 4

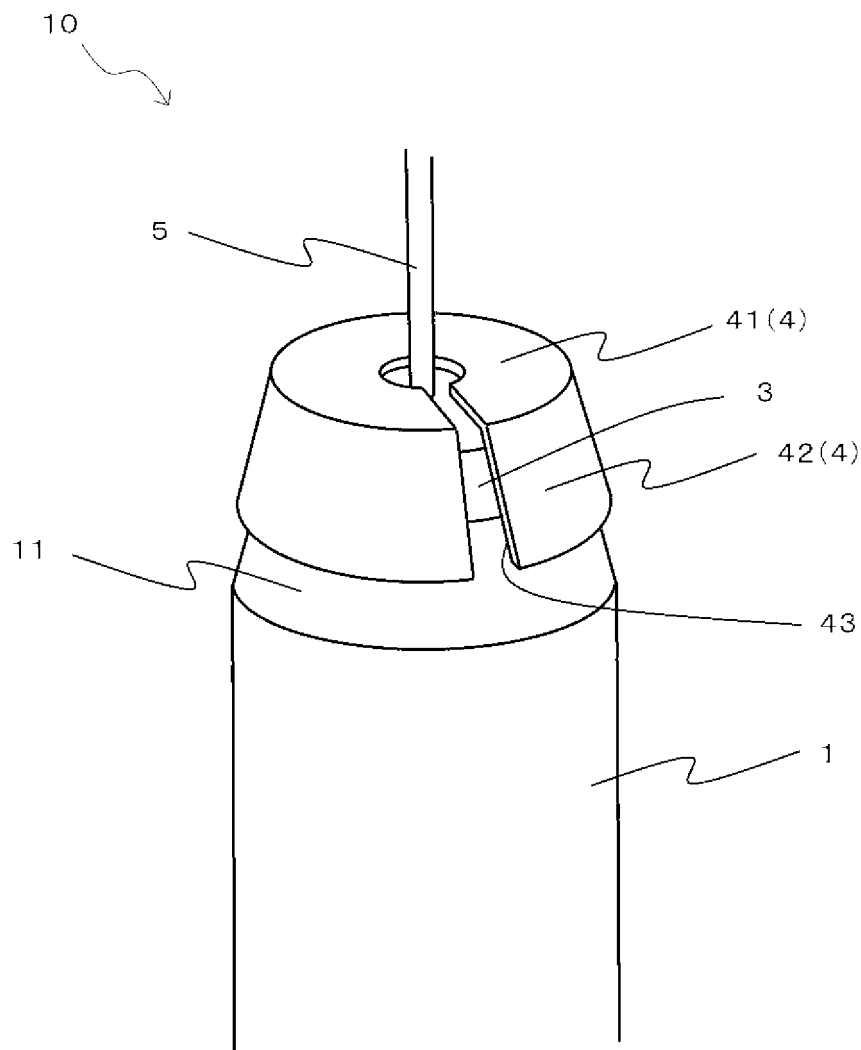
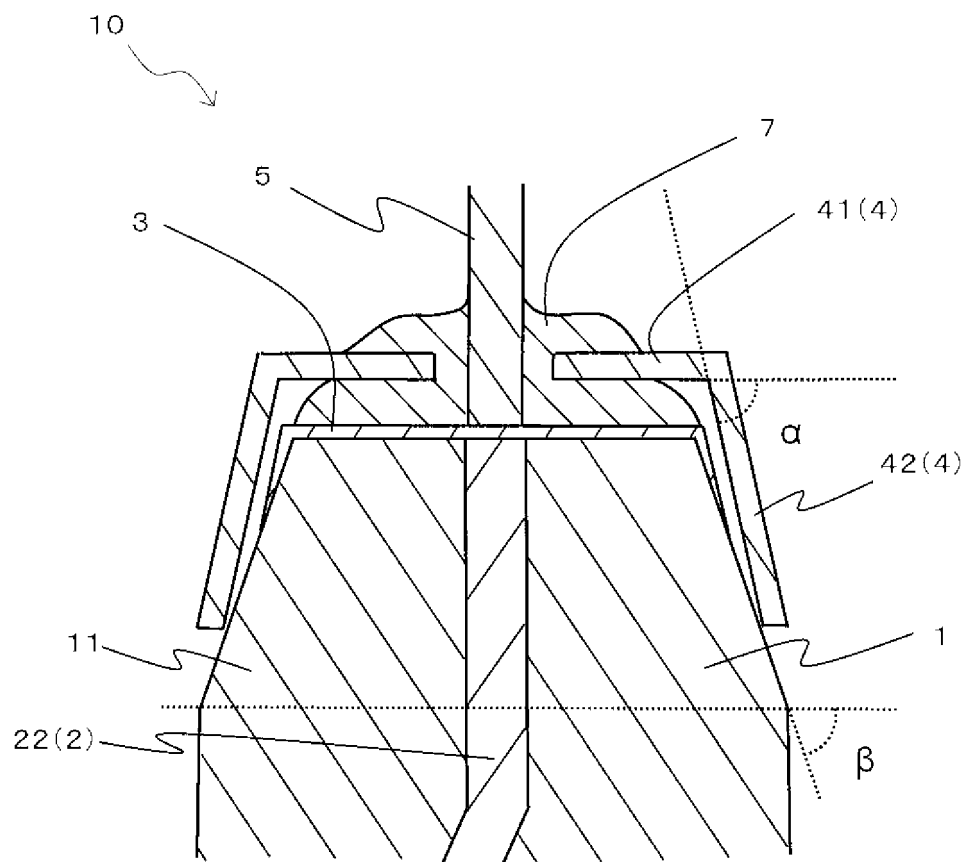


Fig. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/078675

A. CLASSIFICATION OF SUBJECT MATTER

F23Q7/00(2006.01)i, H05B3/02(2006.01)i, H05B3/03(2006.01)i, H05B3/48(2006.01)i

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)

F23Q7/00, H05B3/02, H05B3/03, H05B3/48

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015
Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	WO 2009/096477 A1 (Kyocera Corp.), 06 August 2009 (06.08.2009), paragraphs [0016], [0031], [0037], [0046]; fig. 1, 10 to 12 & US 2011/0068091 A1 & EP 2247156 A1 & WO 2009/096477 A1 & KR 10-2010-0106589 A & CN 101933392 A	1, 4-7 2, 3
Y	JP 7-103478 A (Nippondenso Co., Ltd.), 18 April 1995 (18.04.1995), paragraph [0020]; fig. 8 (Family: none)	1, 4-7

☒ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

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"E" earlier application or patent but published on or after the international filing date

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Date of the actual completion of the international search
13 January 2015 (13.01.15)

Date of mailing of the international search report
20 January 2015 (20.01.15)

Name and mailing address of the ISA/
Japan Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/078675

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2012/0043309 A1 (Yue CHENG), 23 February 2012 (23.02.2012), paragraphs [0026], [0029], [0033]; fig. 2, 6 & EP 2306089 A2 & DE 102009048643 A1 & KR 10-2011-0035958 A & RU 2010139807 A	1, 4-7
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 171413/1986(Laid-open No. 80456/1988) (NGK Spark Plug Co., Ltd.), 27 May 1988 (27.05.1988), page 2, line 11 to page 4, line 6; fig. 2, 3 (Family: none)	1, 4-7
Y	JP 4-43721 Y2 (Kyocera Corp.), 15 October 1992 (15.10.1992), fig. 3 (Family: none)	6, 7
A	JP 2-28044 B2 (NGK Spark Plug Co., Ltd.), 21 June 1990 (21.06.1990), entire text; all drawings & US 4661686 A	1-7
A	JP 7-167434 A (Nippondenso Co., Ltd.), 04 July 1995 (04.07.1995), entire text; all drawings (Family: none)	1-7
A	JP 3121860 B2 (Kyocera Corp.), 09 January 2001 (09.01.2001), fig. 2 (Family: none)	1-7
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 52699/1984(Laid-open No. 165682/1985) (NGK Spark Plug Co., Ltd.), 02 November 1985 (02.11.1985), entire text; all drawings (Family: none)	1-7
A	JP 2005-315447 A (Kyocera Corp.), 10 November 2005 (10.11.2005), entire text; all drawings (Family: none)	1-7

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