

DESCRIPTION

CERAMIC METAL HALIDE LAMP

Technical Field

[0001]

The present invention relates to a ceramic metal halide lamp, in particular, a supporting structure of luminous tube.

Background Art

[0002]

In recent years, ceramic metal halide lamps using a ceramic luminous tube in place of a quartz glass luminous tube have been widely used. Ceramic metal halide lamps can achieve a high luminous efficiency such that the luminous efficiency is equal to or more than 80 lm/W and a high-color-rendering such that the average color rendering index (Ra) is equal to or more than 80. A ceramic metal halide lamp comprises a luminous tube and a translucent outer bulb which encloses the luminous tube. In the luminous tube, inert gas, mercury, metal halides, etc. are enclosed.

Prior Art documents

Patent Literature

[0003]

Patent Literature 1: WO 2006/088128

Patent Literature 2: JP 2005-135665

Patent Literature 3: JP 2006-252842

Summary of Invention

Technical Problem

[0004]

The luminous tube has a light-emitting portion at the center and capillary portions on both ends thereof. From the capillary portions, electrode leads are protruded respectively. During the transportation of lamp, if any vibration or impact is applied to the luminous tube, the capillary portion or electrode lead may be broken. In Patent Literatures 2 and 3, examples of supporting structure for preventing the breakage of the capillary portion are described. In high wattage type ceramic metal halide lamps, the weight of luminous tube is relatively large. Accordingly, the electrode lead may be broken due to the inertia of luminous tube. Preferably, the supporting structure of luminous tube should be simple and be provided with a function for preventing the breakage of electrode lead.

[0005]

An object of the present invention is to provide a supporting structure of luminous tube that has a simple structure and can prevent the breakage of electrode leads on both sides of luminous tube in ceramic metal halide lamp.

Means for Solving the Problem

[0006]

According to an embodiment of the present invention, there is provided a ceramic metal halide lamp comprising: a translucent outer bulb, a luminous tube enclosing a pair of electrodes and having capillary portions on both ends, electrode leads protruding from the pair of the capillary portions respectively, power supply lead wires for supplying power to the electrode leads respectively, and a frame axially

extending outside of the luminous tube, wherein

a supporting structure is provided on one of electrode leads to support the luminous tube, the supporting structure having metal plates, one end of each metal plate being connected to the electrode lead, the other end of each metal plate being connected to the power supply lead wire or the frame, the longitudinal direction of the metal plates being positioned along a direction perpendicular to the axis of the capillary portion, and the width direction of the metal plates being positioned along the axis of the capillary portion.

[0007]

According to an embodiment of the present invention, there is provided the ceramic metal halide lamp, wherein the metal plates include a plurality of belt-shaped metal plates which are positioned side by side along the axis of the capillary portion.

[0008]

According to an embodiment of the present invention, there is provided the ceramic metal halide lamp, wherein the metal plates include a plurality of belt-shaped metal plates which are positioned side by side along the axis of the capillary portion, belt-shaped metal plates of each pair being arranged one on top of the other so as to hold the electrode lead and the second power supply lead wire or frame from both sides.

[0009]

According to an embodiment of the present invention, there is provided the ceramic metal halide lamp, wherein a positioning member is provided, one end of the positioning member being connected to the electrode lead, the other end of the positioning member being connected to the frame, the metal plate and the positioning member extending to opposite sides diametrically from the axis of the capillary portion.

[0010]

According to an embodiment of the present invention, there is provided the ceramic metal halide lamp, wherein the belt-shaped metal plate is made of iron-nickel alloy having a width of 2-6 mm, a length of 25-35 mm, and a thickness of 0.1-0.4 mm.

[0011]

According to an embodiment of the present invention, there is provided the ceramic metal halide lamp, wherein a supporting plate having a central bore is provided on each of the capillary portions, a displacement of each of the capillary portions along the direction perpendicular to the axis of the capillary portion being restricted by insertion of the capillary portions into the bores of the supporting plates respectively.

[0012]

According to an embodiment of the present invention, there is provided the ceramic metal halide lamp, wherein a base is provided on one end of the outer bulb and a stem is mounted on the base, at least one of the frame and the power supply lead wire being connected to and supported by a terminal of the stem.

[0013]

According to an embodiment of the present invention, there is provided the ceramic metal halide lamp, wherein a second electrode lead of electrode leads, the second electrode lead being opposite to the first electrode lead to which the supporting structure is provided, is connected the power supply lead wire or the frame by a metal ribbon.

[0014]

According to an embodiment of the present invention, there is provided the ceramic metal halide lamp, wherein a positioning member is provided, on end of the positioning member being connected to the power supply lead wire, and the other end being connected to the frame.

[0015]

According to an embodiment of the present invention, there is provided the ceramic metal halide lamp, wherein the capillary portion is supported by a metal wire supporting member which makes a cross-link between the frames on both sides of the capillary portion.

Advantageous Effects of Invention

[0016]

According to the present invention, it is possible to provide a supporting structure of luminous tube that has a simple structure and can prevent the breakage of electrode leads on both sides of luminous tube in ceramic metal halide lamp.

Brief Description of Drawings

[0017]

Fig. 1A is a view illustrating a front constitution of an example of ceramic metal halide lamp according to the present invention.

Fig. 1B is a view illustrating a side constitution of an example of ceramic metal halide lamp according to the present invention.

Fig. 2A is a view illustrating an example of supporting structure of luminous tube of ceramic metal halide lamp according to the present invention.

Fig. 2B is a view illustrating an example of supporting structure of luminous tube of ceramic metal halide lamp according to the present invention.

Fig. 3A is a view illustrating a front constitution of another example of ceramic metal halide lamp according to the present invention.

Fig. 3B is a view illustrating a side constitution of another example of ceramic

metal halide lamp according to the present invention.

Fig. 4A is a view illustrating an example of luminous tube of ceramic metal halide lamp according to the present invention.

Fig. 4B is a view illustrating an example of luminous tube of ceramic metal halide lamp according to the present invention.

Fig. 5A is a view illustrating an example of luminous tube of ceramic metal halide lamp according to the present invention.

Fig. 5B is a view illustrating an example of luminous tube of ceramic metal halide lamp according to the present invention.

Description of Embodiment

[0018]

In the following, embodiments of ceramic metal halide lamp according to the present invention will be described in detail with reference to the accompanying drawings. It should be noted that the same elements in the drawings will be denoted by the same reference numerals, and duplicate descriptions will be omitted.

[0019]

With reference to Fig. 1A and Fig. 1B, a first example of ceramic metal halide lamp according to the present invention will be described. Fig. 1A shows a front constitution of the first example of ceramic metal halide lamp according to the present invention, and Fig. 1B shows a side constitution of the first example of ceramic metal halide lamp according to the present invention.

[0020]

The ceramic metal halide lamp has a translucent outer bulb 7 and a luminous tube 1 made of translucent ceramic which is accommodated in the outer bulb. The

luminous tube according to the example has first and second capillary portions 1A and 1B on both sides respectively. The structure of luminous tube 1 will be described below in detail.

[0021]

Within outer bulb 7, a high vacuum state is maintained. In luminous tube 1, inert gas, several kinds of metal halides and mercury having a fill density of about 6.0 mg/cm³ are enclosed. A base 8 is mounted at the end portion of outer bulb 7 and a stem 2 is mounted to the base 8. As shown Fig. 1B, stem 2 is provided with two terminals. Metal frame 3 is mounted to one of the terminals and first power supply lead wire 10a on the base side is connected to the other terminal. As shown in Fig. 1A, second power supply lead wire 10b is connected to frame 3. Power supply lead wires 10a, 10b are fixed to frame 3 or the terminal of stem by welding.

[0022]

Frame 3 has a function to support parts and members within outer bulb 7 but may have a power supply function. In the example shown in the drawings, frame 3 has a closed single rectangular shape, but may have other shape or be made of a plurality of members.

[0023]

Power supply lead wires 10a, 10b have a power supply function but may have a function to support luminous tube 1 as well. Accordingly, frame 3 and power supply lead wires 10a, 10b are made of metal material having a good electrical conductivity and an appropriate rigidity. Frame 3 and power supply lead wires 10a and 10b may have a same material and a same diameter, but may have different materials and different diameters. Two power supply lead wires 10a and 10b may have a same material and a same diameter, but may have different materials and different diameters.

For example, power supply lead wires 10a, 10b may be made of rigid molybdenum wires having a diameter of 1.0 mm.

[0024]

The periphery of luminous tube 1 is surrounded by a cylindrical translucent sleeve 6. Translucent sleeve 6 is supported on frames 3. As shown in the drawings, metal wire 12 is wound along the outer surface of frame 3 and translucent sleeve 6. For example, metal wire 12 may be of a rigid molybdenum wire having a diameter of 0.25~0.60 mm. Both ends of metal wire 12 are welded and fixed to frame 3.

[0025]

From capillary portions 1A and 1B of luminous tube 1, electrode leads 1a and 1b are protruded respectively. First electrode lead 1a on the base side is electrically connected to first power supply lead wire 10a on the base side through metallic ribbon 15 on the base side and further connected to one of terminals of stem 2. Second electrode lead 1b on the opposite to the base, namely, on the top side is electrically connected to second power supply lead wire 10b on the top side through metal plate 14 on the top side and further connected to the other terminal of stem 2 through frame 3. The functions and structures of metal plate 14 and metal ribbon 15 are described below in detail.

[0026]

In this example, first power supply lead wire 10a on the base side is directly fixed to a terminal of stem 2, and second power supply lead wire 10b on the top side is fixed to frame 3. But this is a simple example, and there may be other constitution. For example, both of power supply lead wires 10a and 10b may be directly fixed to each terminal of stem 2. In such a case, frame 3 is directly fixed to the insulating portion of stem 2. Further, metal plate 14 on the top-side may be directly connected to frame 3.

In such a case, since frame 3 has a function of power supply lead wire, second power supply lead wire 10b on the top side is omitted.

[0027]

Between stem 2 and luminous tube 1, a starting circuit is provided. The starting-circuit has a bimetal unit 22 and a non-linear ferroelectric ceramic capacitor (FEC).

[0028]

Supporting plates 5a and 5b are provided on capillary portions 1A and 1B of luminous tube 1, respectively. Supporting plates 5a and 5b are supported by frame 3. Supporting plates 5a and 5b have a supporting bore at the center. Capillary portions 1A and 1B of luminous tube 1 are inserted into supporting bores of supporting plates 5a and 5b respectively. Supporting plates 5a and 5b have a restricting mechanism for restricting the deflection of capillary portions 1A and 1B of luminous tube 1. The restraining mechanism will be described below in detail.

[0029]

Since capillary portions 1A and 1B are inserted into the supporting bores of supporting plates 5a and 5b respectively, the deflection of capillary portions 1A and 1B, namely, the displacement of luminous tube 1 along the direction perpendicular to the axis of luminous tube 1 can be restricted, but the displacement of luminous tube 1 along the axis of luminous tube 1 cannot be restricted. The inner diameters of the bores of supporting plates 5a and 5b may be slightly larger than the outer diameters of capillary portions 1A and 1B of luminous tube 1. Namely, slight gaps may be provided between supporting bores of supporting plates 5a and 5b and capillary portions 1A and 1B of luminous tube 1 respectively. Capillary portions 1A and 1B can be displaced by the amount equivalent to the gap. By controlling the gap, it is possible to adjust the

amount of deflection of capillary portions 1A and 1B.

[0030]

Supporting plates 5a and 5b are formed by plate-shaped thin members and can be deflected. However, even if supporting plates 5A and 5b are deflected, it does not influence the function to restrict the deflection of capillary portions 1A and 1B of luminous tube 1.

[0031]

Supporting plates 5a and 5b have at least a supporting bore at the center and a mounting portion at radially outer peripheral portion, and the shape of supporting plates are not particularly limited. For example, supporting plates may be of a cross-shaped member having a supporting bore at the center, a disk-shaped plate having a supporting bore at the center, or a belt-shaped member having a supporting bore at the center. In addition, the mounting portion at radially outer peripheral portion of supporting plates 5a and 5b may be of a ring shape.

[0032]

The inventors of the present invention have earnestly studied what solutions are necessary in order to prevent the breakage of electrode lead due to impact, even if the weight of luminous tube is relatively large, such as in case of high wattage ceramic metal halide lamp. As the result, the following findings have been obtained. Luminous tube 1 is supported by electrode leads 1a and 1b on both sides. However, if two electrode leads 1a and 1b are fixedly supported, electrode leads may be broken when vibration or impact is applied to luminous tube. Accordingly, one of two electrode lead 1a and 1b may be fixedly supported, but the other should be non-fixedly supported. That is, a supporting structure of luminous tube is provided on one of two electrode leads 1a and 1b. In the present example, the supporting structure of

luminous tube is provided on second electrode lead 1b and is not provided on first electrode lead 1a.

[0033]

Metal ribbon 15 which is connected to electrode lead 1a of first capillary portion 1A of luminous tube 1 will be explained below. One end of metal ribbon 15 is connected to first electrode lead 1a, and the other end is connected to first power supply lead wire 10a. First power supply lead wire 10a is arranged almost in parallel with an axis of first capillary portion 1A. That is, metal ribbon 15 is arranged so as to make a cross-link between first electrode lead 1a of first capillary portion 1A and first power supply lead wire 10a which are nearly in parallel with each other.

[0034]

Metal ribbon 15 can be deflected freely in any direction. Metal ribbon 15 may be formed by a belt-shaped metal plate or metal wire. First electrode lead 1a can be displaced by deflection of metal ribbon 15. That is, first electrode lead 1a is not fixed by metal ribbon 15. However, the displacement of luminous tube 1 in axial direction is restricted by the supporting structure of luminous tube 1.

[0035]

Metal plate 14, which is connected to electrode lead 1b of second capillary portion 1B of luminous tube 1, functions as a supporting structure of luminous tube 1. Second electrode lead 1b of luminous tube 1 is fixedly supported by the supporting structure. This will be described in detail below with reference to Fig.2A and Fig. 2B.

[0036]

Further, positioning member 24 is connected to electrode lead 1b of second capillary portion 1B. Positioning member 24 is an electrical insulation member, which is made of an ordinary carbon resistor from which the carbon film is removed. Thus,

the outer shape of positioning member 24 has a shape of resistor. Positioning member 24 is used to fix the position of the tip of second electrode lead 1b so that second electrode lead 1b of luminous tube 1 is positioned at predetermined position on frame 3 in outer bulb assembling process. In outer bulb assembling process, at first, positioning between frame 3 and luminous tube 1 is carried out. Then, by positioning member 24, frame 3 and the tip end of second electrode lead 1b are connected to each other. In this way, the position of the tip end of second electrode lead 1b is determined. Then, second power supply lead wire 10b is connected to frame 3, and then, second power supply lead wire 10b and second electrode lead 1b are connected to each other by metal plate 14. Positioning member may be used to first electrode lead 1a of luminous tube 1 as well.

[0037]

With reference to Fig. 2A and Fig. 2B, an example of the supporting structure of luminous tube 1 will be described below. Fig. 2A and Fig. 2B are parts which are cut out from Fig. 1A and Fig. 1B, respectively and are magnified. Inventors of the present invention have earnestly considered what solutions should be necessary to prevent an electrode lead from being broken by impact even when the weight of luminous tube is relatively large such as in case of high-wattage ceramic metal halide lamp. As described above, in this example, the supporting structure of luminous tube is provided on second electrode lead 1b and is not provided on first electrode lead 1a. Further, inventors of the present invention have earnestly studied the supporting structure of luminous tube which is provided on second electrode lead 1b and then obtained the following findings. It was found that supporting structure of luminous tube is arranged to fixedly support second electrode lead 1b, but if second electrode lead 1b is completely fixed so as not to allow the deflection of second electrode lead 1b, it

may be broken due to an impact. Accordingly, inventors of the present invention have reached a conclusion that axial displacement of second electrode lead 1b should be restricted, but displacement along the direction perpendicular to axis of second electrode lead 1b should be properly allowed. Namely, in order to prevent the breakage of second electrode lead 1b due to an impact, it is necessary to restrict but also allow properly the deflection of second electrode lead 1b.

[0038]

On both sides of electrode lead 1b of capillary portion 1B, frames 3 are arranged. Frames 3 and second power supply lead wire 10b are arranged almost in parallel with an axis of second capillary portion 1B. To electrode lead 1b, metal plates 14 are connected. Metal plates 14 are extended along a direction perpendicular to the axis of second capillary portion 1B. One end of each metal plate 14 is connected to second electrode lead 1b, and the other end is connected to second power supply lead wire 10b. Metal plates 14 are arranged so as to make a cross-link between second electrode lead 1b and second power supply lead wire 10b which are disposed in parallel with each other. Here, z-axis is set along an axis of second capillary portion 1B, x-axis is set along a line connecting to two frames, and y-axis is set along a direction orthogonal to the x-z plane.

[0039]

In the example of Fig. 2A, metal plates 14 are made of two belt-shaped thin metal plates which are arranged side by side along z-axis direction. In the example of Fig. 2B, metal plates 14 are made of two-pairs of belt-shaped thin metal plates which are arranged side by side along z-axis direction, belt-shaped metal plates of each pair being arranged one on top of the other so as to hold second electrode lead 1b and second power supply lead wire 10b from both sides.

[0040]

In the embodiment, first positioning member 24 is arranged so as to make a cross-link between electrode lead 1b and one of frames 3, and second positioning member 24 is arranged so as to make a cross-link between second power supply lead wire 10b and the other of frames 3. By first positioning member 24, the deflection of electrode lead 1b of second capillary portion 1B is suppressed, and by second positioning member 24, the deflection of second power supply lead wire 10b is suppressed.

[0041]

Further, by metal wire supporting member 16 which is arranged so as to make cross-link between frames 3 on both sides, second capillary portion 1B is supported. Metal wire supporting member 16 is wound around second capillary portion 1B. One end of metal wire supporting member 16 is connected to one of frames 3 and the other end of metal wire supporting member 16 is connected to the other of frames 3. By metal wire supporting member 16, the deflection of second capillary portion 1B is suppressed. Further, first capillary portion 1A may be supported by metal wire supporting member 16 as well.

[0042]

As shown in the drawings, the longitudinal direction of metal plates 14 extends radially from electrode lead portion 1b of second capillary portion 1B and along a direction perpendicularly to second power supply lead wire 10b. The width direction of metal plates 14 is positioned along axes (z-axis) of electrode lead 1b of second capillary portion 1B and second power supply lead wire 10b. The primary plane of metal plate 14, namely a plane including a belt-shaped metal plate is in parallel with axes of second capillary portion 1B and second power supply lead wire 10b.

[0043]

Since metal plates 14 are made of two belt-shaped thin metal plates, they can be curved or deflected around an axis in parallel with z-axis, but cannot be curved or deflected around an axis perpendicular to a plane including the belt-shaped metal plates. Therefore, metal plates 14 suppress the deflection of second electrode lead 1b along a specific direction but allow the deflection of second electrode lead 1b within a range of curvature or deflection of metal plates 14. Metal plates 14 can restrain the displacement of luminous tube along a specific direction but allow the displacement of luminous tube within the range of curvature or deflection of metal plates 14.

[0044]

On the other hand, metal ribbon 15 which is provided on first electrode lead 1a of luminous tube 1 can be deflected freely in any direction of x-axis direction, z-axis direction and y-axis direction. Therefore, metal ribbon 15 allows the displacement of first electrode lead 1a in the three-axes directions, and does not provide a supporting function.

[0045]

In the example of Fig. 2A, metal plates 14 are made of two belt-shaped thin metal plates and in the example of Fig. 2B, metal plates 14 are made of two pairs of belt-shaped thin metal plates. However, these are merely illustrative examples, and metal plates 14 may be made of more than two belt-shaped thin metal plates or more than two pairs of belt-shaped thin metal plates which are arranged side by side along z-axis. According to the present embodiment, by setting the number of belt-shaped metal plates constituting metal plates 14 to a predetermined number, it is possible to obtain a desired strength and a desired rigidity of supporting structure. In case of high-wattage ceramic metal-halide lamp, the weight of luminous tube is relatively large. In

such a case, it is necessary that metal plates 14 have a sufficient strength and rigidity so that it is possible to support the load of luminous tube. In this example, metal plates 14 are made of a plurality of belt-shaped metal plates. Accordingly, when weight of luminous tube is relatively large, the number of belt-shaped metal plates is increased, and when weight of luminous tube is relatively small, the number of belt-shaped metal plates is decreased. Therefore, according to the present invention, even when the weight of luminous tube is changed, it is easy to change the weight loading characteristics of the supporting structure correspondingly.

[0046]

Belt-shaped thin metal plates which form metal plates 14 may be manufactured by cutting a strip-shaped thin metal member to a predetermined length. Dimension of belt-shaped thin metal plate which forms metal plate 14 is not particularly limited. For example, the width of the belt-shaped metal plate may be 2~6 mm, the length may be 25~35 mm, and the thickness may be 0.1~0.4 mm. Preferably, the width of the belt-shaped metal plate is 4 mm, the length is 30 mm and the thickness is 0.2 mm. In addition, metal plates 14 may be made of one belt-shaped thin metal plate having a width larger than that of those belt-shaped thin metal plates in place of a plurality of belt-shaped thin metal plate arranged side by side. Metal plates 14 may be made of any metal material, which has a good conductivity, a sufficient strength, and an appropriate rigidity, for example, nickel, copper, iron, or an alloy of these, or stainless steel. However, preferably metal plates 14 are made of iron-nickel alloy.

[0047]

Metal plates 14 may be connected by welding to second electrode lead 1b of second capillary portion 1A and second power supply lead wire 10b. Such welding may be performed by a resistance welding method.

[0048]

With reference to Fig. 3A and Fig. 3B, a second example of ceramic metal halide lamp according to the present invention will be described. Fig. 3A shows a front constitution of the second example of ceramic metal halide lamp according to the present invention, and Fig. 3B shows a side constitution of the second example of ceramic metal halide lamp according to the present invention.

[0049]

In the first example of Fig. 1A and Fig. 1B, second electrode lead 1b on the top side is fixedly supported by the supporting structure. In this example, first electrode lead 1a on the base side is fixedly supported by the supporting structure.

[0050]

To first electrode lead 1a of first capillary portion 1A on the base side, metal plates 14 are connected. Metal plates 14 are extended along a direction nearly perpendicular to the axis of first capillary portion 1A. One end of each metal plate 14 is connected to first electrode lead 1a, and the other end is connected to first power supply lead wire 10a. Metal plates 14 are arranged so as to make a cross-link between first electrode lead 1a of first capillary portion 1A and first power supply lead wire 10a.

[0051]

The structures of metal plates 14 on the base side may be the same as those of metal plates 14 on the top side which are described with reference Fig. 2A and Fig. 2B. Therefore, in this example, by metal plates 14 on the base side, first electrode lead 1a of luminous tube 1 is fixedly supported.

[0052]

Metal ribbon 15 is connected to second electrode lead 1b on the top side. In this example, second electrode lead 1b on the top side can be displaced by deflection of

metal ribbon 15, but the axial displacement of luminous tube 1 is restricted by a fixedly supporting structure of first electrode lead 1a on the base side.

[0053]

In this example, one end of metal ribbon 15 is connected to power supply lead wire 10b on the top side. However, one end of metal ribbon 15 may be connected directly to frame 3 in place of power supply lead wire 10b. In such a case, since frame 3 can be used also as a power supply lead wire, power supply lead wire 10b on the top side may be omitted.

[0054]

With reference to Fig. 4A and Fig. 4B, examples of structure of luminous tube 1 will be described. Luminous tube 1 has a light-emitting portion 1C at the center and capillary portions 1A and 1B on both sides, and is made of a translucent ceramic. A pair of electrode rods 101a and 101b are positioned inside of luminous tube 1. The tips of electrode rods 101a and 101b are positioned to face each other in light-emitting portion 1C. From capillary portions 1A and 1B, electrode leads 1A and 1B are protruded respectively.

[0055]

In these examples, light-emitting portion 1C and capillary portions 1A and 1B on both sides are formed integrally.

[0056]

Light emitting portion 1c has a spheroidal shape and has a maximum diameter at the center portion. Capillary portions 1A and 1B have a small diameter compared with light-emitting portion 1C.

[0057]

Light-emitting portion 1C of luminous tube 1 has a nearly spheroidal shape but

actually a variety of shapes can be possible. In the example of Fig. 3A, light-emitting portion 1C is in the form of approximately oval shape, but in the example of Fig. 3B, light-emitting portion 1C is in the form of a relatively long spheroidal shape, which is a cylindrical shape to which hemispheres are connected on both sides.

[0058]

With reference to Fig. 5A and Fig. 5B, examples of structure of luminous tube will be described. In the example of Fig. 5A, light-emitting portion 1C and capillary portions 1A on both sides are separately formed respectively and then connected to each other. Into bores of light-emitting portion 1C on both sides, capillary portions 1A and 1B are inserted and connected respectively.

[0059]

In the example of Fig. 5B, light-emitting portion 1C consists of cylindrical member 1E and caps 1F on both sides. Caps 1F each are provided with a center bore. Cylindrical member 1E and caps 1F are manufactured separately, and then connected to each other. On both sides of light-emitting portion 1C as formed in this way, capillary portions 1A and 1B which are manufactured separately are connected respectively.

[0060]

In the above, supporting structures of luminous tube of ceramic metal halide lamp according to the present invention have been described, but these are illustrative, and are not intended to limit the scope of the invention. Any additions, deletions, variations, improvements and so on to the present embodiments, which those skilled in the art can easily perform, are within the scope of the invention. The technical scope of the present invention is determined by the description of the attached claims.

Reference Signs List

[0061]

1: luminous tube,

1A, 1B: capillary portion,

1C: light-emitting portion,

1E: cylindrical member,

1F: cap,

1a, 1b: electrode lead,

2: stem,

3: frame,

5a, 5b: supporting plate,

6: translucent sleeve,

7: translucent outer bulb,

8: base,

10a, 10b: power supply lead wire,

12: metal wire,

14: metal plate,

15: metal ribbon,

16: metal wire supporting member,

22: bimetal unit,

23: non-linear ferroelectric ceramic capacitor (FEC),

24: positioning member,

CLAIMS

1. A ceramic metal halide lamp comprising: a translucent outer bulb, a luminous tube enclosing a pair of electrodes and having capillary portions on both ends, electrode leads protruding from the pair of the capillary portions respectively, power supply lead wires for supplying power to the electrode leads respectively, and a frame axially extending outside of the luminous tube, wherein

a supporting structure is provided on one of electrode leads to support the luminous tube, the supporting structure having metal plates, one end of each metal plate being connected to the electrode lead, the other end of each metal plate being connected to the power supply lead wire or the frame, the longitudinal direction of the metal plates being positioned along a direction perpendicular to the axis of the capillary portion, and the width direction of the metal plates being positioned along the axis of the capillary portion,

wherein the metal plates include a plurality of belt-shaped metal plates which are positioned side by side along the axis of the capillary portion.

2. The ceramic metal halide lamp according to claim 1, wherein the metal plates include a plurality of belt-shaped metal plates which are positioned side by side along the axis of the capillary portion, belt-shaped metal plates of each pair being arranged one on top of the other so as to hold the electrode lead and the second power supply lead wire or frame from both sides.

3. The ceramic metal halide lamp according to one of claims 1 and 2, wherein a positioning member is provided, one end of the positioning member being connected to the electrode lead, the other end of the positioning member being connected to the

frame, the metal plate and the positioning member extending to opposite sides diametrically from the axis of the capillary portion.

4. The ceramic metal halide lamp according to one of claims 1, 2 and 3, wherein the belt-shaped metal plate is made of iron-nickel alloy having a width of 2-6 mm, a length of 25-35 mm, and a thickness of 0.1-0.4 mm.

5. The ceramic metal halide lamp according to one of claims 1, 2, 3 and 4, wherein a supporting plate having a central bore is provided on each of the capillary portions, a displacement of each of the capillary portions along the direction perpendicular to the axis of the capillary portion being restricted by insertion of the capillary portions into the bores of the supporting plates respectively.

6. The ceramic metal halide lamp according to one of claims 1-5, wherein a base is provided on one end of the outer bulb and a stem is mounted on the base, at least one of the frame and the power supply lead wire being connected to and supported by a terminal of the stem.

7. The ceramic metal halide lamp according to one of claims 1-6, wherein a second electrode lead of electrode leads, the second electrode lead being opposite to the first electrode lead to which the supporting structure is provided, is connected the power supply lead wire or the frame by a metal ribbon.