

Description

Title of Invention: HIGH-WATTAGE CERAMIC METAL HALIDE LAMP

Technical Field

[0001]

The present invention relates to a high-wattage ceramic metal halide lamp.

Background Art

[0002]

A high-intensity discharge lamp (HID lamp) emits light by utilizing discharge between electrodes, therefore, the HID lamp has a variety of features such as being more suitable for lighting large spaces because the luminous flux is larger and having better energy efficiency, compared with an incandescent light bulb. In HID lamp, a metal halide lamp employing the metal halide in addition to the mercury as the light-emitting substance has more excellent color rendering close to natural light and higher light emission efficiency, compared with the mercury lamp.

[0003]

Conventionally, the quartz arc tube has been used as the arc tube of the metal halide lamp. Recently, a translucent ceramic arc tube has replaced it. As compared to the quartz arc tube, the translucent ceramic arc tube can increase the life because of having better heat resistance, furthermore, has the advantage such as a variety of metal halide can be used because the reaction with a metal halide enclosed in the arc tube is less.

Citation List

Patent Literature

[0004]

Patent Literature 1: WO 2006-088128, "Ceramic Metal Halide Lamp with Rated

Lamp Power of 450W or more" (International Publication Date: August 24, 2006),
Applicant: GS Yuasa Corporation

Patent Literature 2: JP 2002-110100 A, "High-Pressure Discharge Lamp,
High-Pressure Discharge Lamp Lighting Device and Lighting Device", (Publication
Date: April 12, 2002), Applicant: Toshiba Lighting & Technology Corporation

Patent Literature 3: JP 2008-027745 A, "Metal Halide Lamp and Lighting
Device", (Publication Date: February 7, 2008), Applicant: Osram-Melco Toshiba
Lighting Corporation

Patent Literature 4: JP 2009-283433 A, "High-Pressure Discharge Lamp and
Lighting Device", (Publication Date: December 3, 2009), Applicant: Toshiba Lighting
& Technology Corporation

Patent Literature 5: JP 2010-218988 A, "High-Pressure Discharge Lamp and
Lighting Device", (Publication Date: September 30, 2010), Applicant: Toshiba Lighting
& Technology Corporation

[0005]

(Comparison of Patent Literatures and the Present Invention)

Patent Literature 1 is directed to the ceramic halide lamp of 450 W or more.
As a problem, it cites a flicker because the arc is unstable (paragraph 0010). In order
to solve this problem, the relation between the inner diameter of the main pipe D (mm),
the electrode protruding length L (mm), and the distance between the electrodes E (mm)
is defined that the tube wall load G (w/cm^3) represented by $G = W/(3.14 \times D \times E \times$
 $0.01)$ is in the range of $15 \leq G \leq 40$, and is defined as $0.32 \leq L/D \leq 0.003 \times W + 0.465$
(claim 1). The present invention defines the decrease in the light emission efficiency
as the problem, and is different from the Patent Literature 1 in that the air gap in the
inside of the thin tube part is specified in two dimensions and three dimensions.

[0006]

Patent Literature 2 defines the width of the pole gap in absolute value

(paragraph 0041). The present invention defines the decrease in the light emission efficiency as the problem, and is different from the Patent Literature 2 in that the air gap in the inside of the thin tube part is specified in two dimensions and three dimensions.

[0007]

Patent Literature 3 is directed to a rated lamp power of 400 W (paragraph 0091), and is different from the present invention in the subject matter. Patent Literature 4 is directed to a rated lamp power of 100 W or less (paragraphs 0022 and 0024), and is different from the present invention in the subject matter. Patent Literature 5 is directed to a rated lamp power of 100 W (paragraph 0033), and is different from the present invention in the subject matter.

Summary of Invention

Technical Problem

[0008]

Conventionally, a low and medium-wattage lamp of 100 to 300 watts class has been the mainstream of ceramic metal halide lamps. In such a situation, the present inventors aims the development of high-wattage lamp of 500 watts or more having larger luminous flux and being suitable for lighting of larger-scale space.

However, in a high-wattage ceramic metal halide lamp, a phenomenon that the light emission efficiency is decreased has occurred for some reason. The decrease in light emission efficiency is a phenomenon which has not been observed in conventional low and medium-wattage lamps.

Therefore, ascertaining the cause of the light emission efficiency decreases, solving this, and realizing the high-wattage ceramic metal halide lamp with high light emission efficiency have been desired.

[0009]

Therefore, the object of the present invention is to provide a high-wattage ceramic metal halide lamp maintaining high light emission efficiency.

Solution to Problem

[0010]

In view of the above object, a high-wattage ceramic metal halide lamp of the present invention comprises an arc tube sealing at least mercury and metal halide, wherein the arc tube includes a thick tube part, and a pair of thin tube parts formed on both ends of the thick tube part, and a current conduction member is passed through an inside of each of the thin tube parts, an outer diameter L14 of the current conduction member as compared with an inner diameter L6 of the thin tube part is in a range of $0.96 \leq L14/L6 \leq 0.98$, and an area between the thin tube part and the current conduction member is divided into a sealed area and a non-sealed area, and an air gap GA in the non-sealed area is in a range of $5.0 \text{ mm}^3 \leq GA \leq 17.5 \text{ mm}^3$.

[0011]

As for the above high-wattage ceramic metal halide lamp, the metal halide lamp may have a rated lamp power in a range of 500 to 1000 W.

[0012]

As for the above high-wattage ceramic metal halide lamp, the current conduction member may be a metal coil-wound rod where a metal coil is wound around a metal rod.

[0013]

As for the above high-wattage ceramic metal halide lamp, the inner diameter of the thin tube part may be in a range of 2 to 3 mm.

[0014]

As for the above high-wattage ceramic metal halide lamp, mercury sealed in the arc tube may weigh a maximum of 100 mg, and rare earth metal halide sealed in the arc tube may weigh a maximum of 12 mg.

Advantageous Effects of Invention

[0015]

According to the present invention, it is possible to provide a high-wattage ceramic metal halide lamp maintaining high light emission efficiency.

Brief Description of Drawings

[0016]

Fig. 1 is a diagram showing a high-wattage ceramic metal halide lamp according to the present embodiment.

Fig. 2A is a diagram for explaining the entire arc tube.

Fig. 2B is an enlarged view of a thin tube part enclosed by a broken line rectangle in Fig. 2A.

Fig. 3 is a cross-sectional view of Fig. 2B along the line III-III.

Fig. 4 is an enlarged view of the thin tube part shown in Fig. 2B.

Fig. 5 is a graph illustrating the Table 1.

Fig. 6A is a diagram showing a representative example of the shape of the arc tube according to the embodiment, and corresponds to Fig. 2A.

Fig. 6B is a diagram showing a representative example of the shape of the arc tube according to the embodiment, and corresponds to Fig. 2B.

Description of Embodiments

[0017]

In the following, the embodiments of high-wattage 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 in the figures, the same reference numerals will be given to the same elements, and an overlapping description will be omitted. It should be noted that the present embodiment is an illustration for explaining the present invention, and it should be aware that the present embodiment is not intended to limit any of the scope of the present invention.

[0018]

[High-Wattage Ceramic Metal Halide Lamp]

Fig. 1 is a diagram illustrating the structure of a high-wattage ceramic metal halide lamp according to the present embodiment. The high-wattage type is a lamp of 500 to 1000 watts class, and typically a lamp of 700 watts class. Lamp 10 includes arc tube 6 serving as the light-emitting part inside outer bulb 2, and inner tube (also is referred to as "sleeve") 8 surrounds the periphery of arc tube 6. At the end of outer bulb 2, E-shaped base 12 is joined. Arc tube 6 is supported in a predetermined position by mount 14 where inner tube 8 is attached to a structure having a combination of a wire and a plate of metal, and is powered.

[0019]

Each of these elements will be briefly explained.

As for arc tube 6, it will be described in detail in relation to Figs. 2 and 3 below.

[0020]

Mount 14 includes stem tube 16 where a pair of lead-in wires is airtightly sealed, and support column 18 generally shaped in an inverted U-shape, as main components.

[0021]

Inner tube 8 is made of transparent quartz glass tube, and is disposed so as to surround the periphery of the arc tube to prevent damage to outer bulb 2 when arc tube 6 is broken. Wire 20 is wound spirally around inner tube 8 so as to reinforce the mechanical strength of inner tube 8.

[0022]

Outer bulb 2 is made of, for example, transparent hard glass such as borosilicate glass. Outer bulb 2 has a BT-shape including central part 2a of the maximum aperture, occluded top part 2b on upper side as viewed in the figure, and neck part 2c on lower side. Neck part 2c include a sealing part (not shown) where a flared part of stem tube 16 is sealed. After sealing, the outer bulb is exhausted inside through the exhaust tube (not shown) disposed at the stem tube 16, and is in an airtight atmosphere wherein inert gases such as argon (Ar) and nitrogen (N₂) are filled in or a vacuum state is kept.

[0023]

To cover the sealing part, screw-type base 12 is joined together using a heat-resistant adhesive, or is screwed to the helical screw groove formed by the mold.

[0024]

The lamp shown in Fig. 1 is energized from the power source via a predetermined lighting circuit (not shown) by attaching base 12 to the socket (not shown), and stable lighting is continued by the discharge between the main electrodes disposed inside arc tube 6.

[0025]

[Arc Tube]

(Structure of Arc Tube)

Figs. 2A and 2B are diagrams for explaining the details of arc tube 6, where Fig. 2A is a diagram illustrating the entire arc tube, and Fig. 2B is an enlarged view of thin tube part 6b surrounded by a broken line rectangle in Fig. 2A. As shown in Fig. 2A, arc tube 6 is a translucent ceramic container formed integrally of a substantially spheroidal-shaped thick tube part (also referred to as "light-emitting part") 6a at the center, and thin tube parts (also referred to as "capillary") 6b and 6c at both ends. It should be noted that the shape of arc tube 6 is not limited to this, and that the shape of arc tube 6 may be the shape having thin tube parts 6b and 6c, disposed at both ends of thick tube part 6a of the cylindrical shape and the like, each of which being formed of a member different from the thick tube part.

[0026]

Left and right of thin tube parts 6b and 6c have the same structure, and a pair of respective leads 22-1 and 22-2 extends to the area of thick tube part 6a through these thin tube parts, and forms a pair of main electrode 24-1 and 24-2 made of tungsten (W). In the container of thick tube part 6a, as the light emission and discharge medium, for example, maximum 100 mg (preferably, about 85 mg) of mercury, maximum 12 mg

(preferably, about 7 mg) of a metal halide containing a rare earth metal halide, and Argon (Ar) or the like on which a predetermined pressure is applied as a rare gas are sealed, and improvement of characteristics such as light emission efficiency, color rendering properties, and color temperature is aimed.

[0027]

As shown in Fig. 2B, lead 22-1 is inserted from the tip of thin tube part 6b connecting to thick tube part 6a along the axis of the arc tube, leads to cermet (alloy of molybdenum and alumina) 26, and further leads to metal coil-wound rod (also referred to as "current conduction member") 30, and beyond metal coil-wound rod 30, tungsten electrode rod 24-1 is formed, and niobium stopper member 32 is welded to the cermet. Thus, the thing integrally connecting main electrode 24-1, current conduction member 30, cermet 26, lead 22-1, and niobium stopper member 32 is referred to as an electrode mound.

[0028]

Metal coil-wound rod 30 is typically formed by molybdenum coil 30-2 being wound around molybdenum rod-shaped body 30-1 that serves as the core rod. However, it is not limited to this. For example, metal rod with coil 30 may be formed of a metal such as tungsten (W) or other metals, a combination of metal such as molybdenum, tungsten and other metals, or an alloy. The tip part inside thin tube part 6b is sealed by glass frit (seal material) 28, and furthermore is reinforced by ceramic ring member 34 passed through lead line 22-1.

[0029]

During the lamp manufacturing, the electrode mount is inserted into thin tube part 6b so that niobium stopper member 32 is caught by the tip part of thin tube part 6b, and glass frit 28 and ceramic ring member 34 are mounted on the thin tube part end portion. In this state, the glass frit is melted by heating the periphery of the thin tube part end portion with a heater (not shown). The melted glass frit penetrates through

the inside of the thin tube part by a capillary phenomenon to solidify, and seals the inside of arc tube 6 from the outside. Thin tube part 6c also has the same structure as thin tube part 6b.

[0030]

(Causes and Measures of Light Emission Efficiency Decrease)

Fig. 3 is a cross-sectional view of Fig. 2B along the line III-III. It should be noted that as for the reference numerals in the drawings, refer to Figs. 4 and 6 at a suitable time. Molybdenum coil rod 30 is inserted into thin tube part 6b. There is molybdenum coil 30-2 around molybdenum rod-shaped body 30-1 forming molybdenum coil rod 30.

[0031]

During the arc tube production, metal halide is encapsulated inside thick tube part 6a in the solid state (powder, pellets, and the like). When the lamp is lit, the inside of the arc tube becomes a state of a high temperature and a high pressure, therefore, metal halide becomes a mixed state of liquid and gas. In the metal halide lamp, the vaporized metal halide penetrates, although slightly, into the air gap inside the thin tube part toward the thin tube part tip, and has a tendency to accumulate by being liquefied near molybdenum coil-wound rod 30 with a relatively low temperature. The liquefied metal halide erodes the polycrystalline alumina forming thin tube parts 6b and 6c.

[0032]

As a countermeasure against this, the gap between thin tube part 6b of the arc tube and molybdenum coil-wound rod 30 is made very small as viewed in cross-section, that is, two-dimensionally, and the gap inside the thin tube part is made very narrow. Furthermore, molybdenum coil-wound rod 30 employs a structure where coil 30-2 is wound around rod-shaped body 30-1 so as to reduce the heat transfer of the thick tube part, and to prevent the intrusion of a metal halide.

[0033]

In the conventional low and medium-wattage lamp, generally, outer diameter L14 of molybdenum coil-wound rod 30 as compared with inner diameter L6 of the thin tube part has been represented as $L14/L6 = 0.90$ to 0.95 . If the gap inside the thin tube part is increased by reducing the ratio of $L14/L6$, while it has an advantage such as that the molybdenum coil-wound rod 30 can be easily inserted into the thin tube part during manufacturing, it tends to cause the intrusion of the metal halide. On the contrary, if the gap inside the thin tube part is reduced by increasing the ratio of $L14/L6$, molybdenum coil-wound rod 30 heated by the heat from the thick tube part and expanded thermally when the lamp is lit, makes contact with the inner wall of thin tube part 6b, and damages the inner wall. For example, in the low and medium-watt lamp, the molybdenum coil-wound rod of the outer diameter 1.2 mm is inserted in the thin tube part of the inner diameter $L6 = 1.28$ mm. $L14/L6 = 0.938$.

[0034]

In the design of a high-wattage lamp, the current flowing through arc tube 6 is larger, therefore, there is a need to thicken molybdenum coil-wound rod 30, and the inner space of thin tube parts 6b and 6c for accommodating molybdenum coil-wound rod 30 is also required to be thickened. Initially, the thickness of molybdenum coil-wound rod 30 is determined from the current capacity to be required, and inner diameter L6 of the thin tube part is determined from the same ratio of $L14/L6$ as that of the low and medium-watt lamp.

[0035]

However, as described above, in a high-wattage ceramic metal halide lamp, the phenomenon that light emission efficiency is lowered for some reason occurs. This reduction in light emission efficiency is a phenomenon not observed in conventional low and medium-wattage lamps. As for the high-wattage metal halide lamp, in the same ratio of $L14/L6$ as that of the low and medium-watt lamp, it is suspected that a metal halide intrudes into the air gap inside the thin tube part, and reduces the light

emission efficiency greatly.

[0036]

Then, the present inventors take the following two strategies so as to prevent the metal halide from penetrating into the air gap inside the thin tube part.

[0037]

The first strategy is to prevent the intrusion of the metal halide by increasing as much as possible the outer diameter of molybdenum coil-wound rod 30 against the inner diameter of the thin tube part to narrow the gap, as viewed two-dimensionally in the thin tube part cross section shown in Fig. 3.

Therefore, outer diameter L14 of molybdenum coil-wound rod 30 as compared with inner diameter L6 of the thin tube part is set as 0.96 or more which at least exceeds the $L14/L6 = 0.90$ to 0.95 in low and medium-watt lamps. In view of the thermal expansion of molybdenum coil-wound rod 30 when the lamp is lit, it is required to be 0.98 or less. Therefore, it is set in the range of $0.96 \leq L14/L6 \leq 0.98$.

[0038]

The second strategy is to reduce the space that is subjected to additive intrusion by three-dimensionally reducing the air gap inside the thin tube part (the remaining space excluding the space occupied by the molybdenum coil-wound rod from the space of the inside of the thin tube part).

[0039]

Fig. 4 is an enlarged view of thin tube part 6b shown in Fig. 2B. Thin tube part 6b is a part from boundary CB with thick tube part 6a to end portion 6be. Boundary CB of thin tube part 6b and thick tube part 6a is a point where the internal diameter of the thin tube part starts to expand toward the thick tube part. The inner diameters of thin tube parts 6b and 6c are within the range of 2 to 3 mm. Here, the inside space of thin tube part 6b is referred to as thin tube part inside space CA, and among thin tube part inside space CA, the space occupied by solidified glass frit 28 is referred to as

sealed area SA, and the remaining space is referred to as non-sealed area NSA. There is a relation of $CA = SA + NSA$. Furthermore, among non-sealed area NSA, the space occupied by molybdenum coil-wound rod 30 is referred to as molybdenum coil-wound rod area MA, and the remaining space is referred to as air gap GA inside the thin tube part. There is a relation of $NSA = MA + GA$.

[0040]

With respect to a high-wattage lamp, the arc tubes with varied air gaps GA inside the thin tube part are produced experimentally within the range of $0.96 \leq L14/L6 \leq 0.98$ which is the first strategy, and the relation between air gap GA inside the thin tube part and light emission efficiency η is investigated. Light emission efficiency η represents the efficiency of the light source, and is a total luminous flux (lumens per watt lm/W) per unit power. Table 1 is the experiment data, and Fig. 5 is a graph illustrating this.

[0041]

[Table 1]

Table 1: Air gap GA inside the thin tube part and Light emission efficiency η

Sample No.	Air gap GA inside the thin tube part (mm ³)	Light emission efficiency η (lm/W)
1	25.8	60.0
2	21.0	80.0
3	17.6	109.0
4	14.6	112.6
5	11.6	107.0

[0042]

As shown in Fig. 5, when air gap GA of non-sealed area is up to around 17.5 mm³, the light emission efficiency is maintained 100 (lm/W) or more, but when air gap GA exceeds this, the light emission efficiency η is rapidly decreased, and when air gap

GA is around 25.0 mm^3 , the light emission efficiency η is reduced to about half, that is, 50 to 60 (lm/W).

[0043]

From this result, in the high-wattage lamp, one of the causes that light emission efficiency is rapidly decreased is found by the fact that gap GA inside the thin tube part is large, and the metal halide can easily penetrate into the gap GA, therefore, the light emission efficiency is greatly affected. That is, the present inventors have initially expected that the penetration of the metal halide into the inside of the thin tube part can be prevented by employing the molybdenum coil-wound rod with the same ratio of L14/L6 as that of the low and medium-wattage lamp. However, in the high-wattage lamp, beyond this expectation, it is found that the metal halide penetrates, and reduces the light emission efficiency.

[0044]

When the metal halide enters into gap GA, the amount of metal halides contributing to the light emission inside the thick tube part decreases, and the luminous flux is reduced. Furthermore, the ratio of the light-emitting substance inside the thick tube part becomes a mercury-rich state, the arc temperature rises, and the temperature of the alumina forming arc tube 6 is further increased. As a result, inner tube 8 surrounding arc tube 6 is blackened by the deoxidization of alumina forming arc tube 6, and the lamp illumination is reduced.

[0045]

In contrast to this, it has also been tried to increase the metal halide within the arc tube in advance so that the metal halide sufficient for light emission remains in the thick tube part even when the metal halide intrudes into air gap GA. However, the increase of the metal halide causes the unstable arc when discharging, and results in the flicker occurring.

[0046]

From the results shown in Fig. 5, the upper limit of air gap GA in non-sealed area is required to be 17.5 mm³ or less so as to maintain high light emission efficiency η of 100 (lm/W) or more. The lower limit of air gap GA is set as 5.0 mm³ or more so as to avoid contact with thin tube parts 6b and 6c by thermal expansion of molybdenum coil-wound rod 30 during lighting, and to satisfy the request from the lamp manufacture. Therefore, air gap GA is determined to be in the range of $5.0 \text{ mm}^3 \leq \text{GA} \leq 17.5 \text{ mm}^3$.

[0047]

As a result, in the high-wattage metal halide lamp, high light emission efficiency was maintained by the first strategy and the second strategy.

[0048]

(Shape Example of Arc Tube)

Figs. 6A and 6B are diagrams showing a representative example of the shape of the arc tube according to the present embodiment, and respectively correspond to Figs. 2A and 2B. As shown in Fig. 6A, $L1 = \phi 24 \text{ mm}$ where L1 denotes the outer diameter dimension of thick tube part 6a, $L2 = \phi 21.8 \text{ mm}$ where L2 denotes the inner diameter dimension, $L3 = 34 \text{ mm}$ where L3 denotes the distance between the electrodes (corresponding to the "arc length"), and $L4 = 107 \text{ mm}$ where L4 denotes the distance between the end portions of thin tube parts 6b and 6c, of arc tube 6.

[0049]

As shown in Fig. 6B, $L5 = \phi 4.5 \text{ mm}$ where L5 denotes the outer diameter dimension, and $L6 = \phi 2.3 \text{ mm}$ where L6 denotes the inner diameter dimension, of the thin tube part. Boundary CB between each thin tube part 6b or 6c and thick tube part 6a is defined as the point where the inner diameter of the thin tube part starts to expand toward the thick tube part. $L7 = 21.5 \text{ mm}$ where L7 denotes the axial direction dimension of each thin tube part 6b or 6c, and $L8 = 4.5 \text{ mm}$ where L8 denotes the axial direction dimension of each glass frit 28 forming a sealed area by being welded to the inside of the end portion of the thin tube part. As for molybdenum coil-wound rod 30,

$L12 = \phi 1.0$ mm where $L12$ denotes the outer diameter of molybdenum rod-shaped body 30-1 that is a core rod, $L11 = 16$ mm where $L11$ denotes the axial direction dimension of molybdenum coil-wound rod 30, $L13 = \phi 0.62$ mm where $L13$ denotes the outer diameter dimension of molybdenum coil 30-2, and $L14_{\max} = \phi 2.24$ mm where $L14_{\max}$ denotes the maximum outer diameter dimension of coil wound around molybdenum rod-shaped body 30-1. In this example, $L14/L6 = 0.974$, therefore, $L14/L6$ is in the range of $0.96 \leq L14/L6 \leq 0.98$.

[0050]

[Conclusion]

Although embodiments of a high-wattage ceramic metal halide lamp according to the present invention are described above, the present invention is not limited to this. The addition, modification, improvement, and the like to the present embodiment, which those skilled in the art can easily perform, are within the scope of the present invention. The technical scope of the present invention is determined based on the description of the appended claims.

Reference Signs List

[0051]

- 2 outer bulb
- 2a central part
- 2b top part
- 2c neck part
- 6 arc tube, discharge tube
- 6a thick tube part, light emitting part
- 6b and 6c thin tube part
- 8 inner tube, sleeve
- 10 metal halide lamp, lamp
- 12 E-shaped base

14	mount
16	stem tube
18	support column
20	wire
22	lead
24	tungsten electrode rod, main electrode
26	cermet
28	glass frit
30	metal coil-wound rod, molybdenum coil-wound rod
30-1	metal rod, molybdenum rod-shaped body,
30-2	metal coil, molybdenum coil
32	niobium stopper member
34	ceramic ring member
CA	thin tube part inside space
CB	boundary
CB	boundary
SA	sealed area
NSA	non-sealed area

Claims

1. A high-wattage ceramic metal halide lamp comprising:
an arc tube sealing at least mercury and metal halide,
wherein the arc tube includes a thick tube part, and a pair of thin tube parts
formed on both ends of the thick tube part, and a current conduction member is passed
through an inside of each of the thin tube parts,
an outer diameter L14 of the current conduction member as compared with an
inner diameter L6 of the thin tube part is in a range of $0.96 \leq L14/L6 \leq 0.98$, and
an area between the thin tube part and the current conduction member is divided
into a sealed area and a non-sealed area, and an air gap GA in the non-sealed area is in a
range of $5.0 \text{ mm}^3 \leq GA \leq 17.5 \text{ mm}^3$.
2. The high-wattage ceramic metal halide lamp according to claim 1,
wherein the metal halide lamp has a rated lamp power in a range of 500 to 1000
W.
3. The high-wattage ceramic metal halide lamp according to claim 1,
wherein the current conduction member is a metal coil-wound rod where a metal
coil is wound around a metal rod.
4. The high-wattage ceramic metal halide lamp according to claim 1,
wherein the inner diameter of the thin tube part is in a range of 2 to 3 mm.
5. The high-wattage ceramic metal halide lamp according to claim 1,
wherein mercury sealed in the arc tube weighs a maximum of 100 mg, and rare
earth metal halide sealed in the arc tube weighs a maximum of 12 mg.