

DISCHARGE LAMP

BACKGROUND OF THE INVENTION

Technical Field

[0001]

Devices and apparatuses consistent with the present invention relate to discharge lamps, and, more particularly, to discharge lamps having a hermetic sealing structure suitable for a high current.

Related Art

[0002]

Generally, a discharge lamp, for example, a mercury lamp is widely used in various fields such as a photochemical industrial field and a semiconductor manufacture field in which an ultraviolet ray emitted from a lamp is used.

[0003]

In an ultrahigh-pressure mercury lamp or a high-pressure mercury lamp for a high current, a gas pressure inside a light emitting tube is very high upon turning on the lamp due to a large amount of enclosed mercury which is served as a main component of light emitting gas, and also the heating value of the lamp is considerably large. Accordingly, in particularly, a high heat-resisting property and a high pressure-resisting property is required for glass of a hermetic sealing portion. In addition, the mercury enclosed inside the light emitting tube needs to completely evaporate upon turning on the lamp. For this reason, it is necessary to remove a low-temperature portion for allowing the mercury to condense inside the light emitting tube upon turning on the lamp.

[0004]

For this reason, in the related-art ultrahigh-pressure mercury lamps or high-pressure mercury lamps, a so-called foil sealing structure using a sealing metal foil is employed instead of a so-called rod sealing structure for hermetically sealing a tube by directly welding glass forming the tube to a power feeding lead rod.

[0005]

Fig. 7 is an explanatory view showing an example of a high-pressure mercury lamp having a foil sealing structure. Reference numeral 1 denotes a discharge container including a light emitting tube 11 and a sealing tube 12 which is connected to the light emitting tube 11. An electrode 2 is disposed inside the light emitting tube 11 of the discharge container 1, and the electrode 2 is held by an inner lead 3. The inner lead 3 may be formed in a rod shape. Also, the inner lead 3 is held in the sealing tube 12 by a glass holding cylinder body 4 for holding the inner lead 3.

[0006]

In addition, the rear end of the inner lead 3 on the opposite side of the electrode 2 is inserted through a through hole of a disk 5 formed of metal such as molybdenum having a high melting point, and welded to the disk 5. A metal foil 6 is welded to a surface of the disk 5 on the side of the light emitting tube 11. For example, five sheets of metal foils 6 are formed on the outer periphery of the cylindrical glass member 7 along an axial direction of the glass member 7 so as to be spaced from each other.

[0007]

In addition, the other end of the metal foil 6 welded to the disk 5 is welded to a metal member 8 which is formed in a plate shape, and is electrically connected to an outer lead 9 via the metal member 8.

The outer lead 9 is held by a glass holding cylinder body 41 for holding the

outer lead 9. Also, the outer lead 9 passes through the metal member 8 to be welded to the metal member 8 and to be inserted into a hole 71 formed in the glass member 7. The outer lead 9 may be formed in a rod shape.

[0008]

In addition, a metal foil M1 formed of molybdenum is disposed between the glass member 7 and the disk 5. A metal foil M2 formed of molybdenum is disposed between the disk 5 and the holding cylinder body 4 for holding the inner lead 3.

As shown in Fig. 8A, the metal foil M1 is a disc-shaped metal foil having no through hole, and has almost the same diameter as that of the disk 5.

As shown in Fig. 8B, the metal foil M2 is an annular metal foil in which a through hole is formed at the center thereof so as to allow the inner lead 3 to be inserted therein, and has almost the same diameter as that of the disk 5.

Further, since the other-side sealing tube has the same structure, the description thereof will be omitted herein.

[0009]

The electrode 2 is inserted so as to be located inside the light emitting tube 11 of the discharge container 1 with such a configuration. Then, a heating process using a burner or the like is performed on the outside of the sealing tube 12 while rotating the discharge container 1 in a circumferential direction using a glass lathe or the like, so that the inner periphery of the sealing tube 12 is hermetically welded to the outer periphery of the glass member 7 via the metal foil 6.

Further, a heating process is performed on a portion of the sealing tube 12 facing the holding cylinder body 4, so that the inner periphery of the sealing tube 12 is welded to the holding cylinder body 4.

Furthermore, since the other-side sealing tube has the same structure, the

description thereof will be omitted herein.

[0010]

In the heating process of the sealing tube 12, when the glass member 7 comes into contact with the disk 5, a micro crack may be generated in the glass member 7 due to a difference between the expansion coefficients of the respective members. For this reason, the metal foil M1 is provided between the glass member 7 and the disk 5 so that the glass member 7 does not come into contact with the disk 5.

In the same manner, in the heating process of the sealing tube 12, when the disk 5 comes into contact with the holding cylinder body 4 for holding the inner lead 3, a micro crack may be generated in the holding cylinder body 4 due to a difference between the expansion coefficients of the respective members. For this reason, the metal foil M2 is provided between the holding cylinder body 4 and the disk 5 so that the holding cylinder body 4 does not come into contact with the disk 5.

Further, depending on the type of the lamp, there exists a lamp in which the metal foil M2 is not provided between the holding cylinder body 4 and the disk 5.

[0011]

However, even in the structure in which the metal foil M1 is provided between the glass member 7 and the disk 5, a crack may be generated in a portion of the glass member 7 coming into contact with the metal foil M1 in some cases during the heating process using the burner or the like which is performed on the outside of the sealing tube 12, and further may increase upon turning on the lamp. As a result, gas enclosed inside the light emitting tube 11 may leak or the sealing tube 12 may be broken.

[0012]

As shown in Fig. 9, the rear end portion 3a of the inner lead 3 on the opposite side of the electrode 2 is inserted through the through hole of the disk 5 and welded to

the disk 5. However, with this structure, it is difficult to align the rear end portion 3a of the inner lead 3 with the end surface 5a of the disk 5. Thus, in some cases, the rear end portion 3a of the inner lead 3 is welded to the disk 5 so as to protrude from the end surface 5a of the disk 5

In such a structure, in the heating process using the burner or the like which is performed on the outside of the sealing tube 12, the rear end portion 3a protruding from the end surface 5a may push the metal foil M toward the glass member 7, and thus a crack may be generated in the pushed portion of the glass member 7 (*see e.g.*, JP-A-2000-149873).

SUMMARY OF THE INVENTION

[0013]

It is an aspect of the present invention to provide a discharge lamp having a long durability. According to the discharge lamp of the present invention, a crack can be prevented from being generated in a glass member disposed inside the sealing tube, and thus a sealing tube can be prevented from being broken so that gas can be prevented from leaking from a light emitting tube.

[0014]

According to a first aspect of the present invention, there is provided a discharge lamp. The discharge lamp comprises:

a light emitting tube (11);

a sealing tube (12) connected to an end portion of the light emitting tube;

a cylindrical glass member (7) disposed inside the sealing tube;

a metallic disk (5) having a through hole therein and disposed inside the sealing tube so as to face an end surface of the cylindrical glass member on the side of the light

emitting tube;

an inner lead (3) formed in a rod shape, wherein one end side of the inner lead (3) extends to the inside of the light emitting tube and connected to an electrode (2), and the other end side of the inner lead (3) is inserted through the thorough hole of the disk and fixed to the disk;

a glass holding cylinder body (4) disposed between the outer periphery of the inner lead and the inner periphery of the sealing tube so as to hold the inner lead; and

a metal foil (6) extending along the outer periphery of the glass member, wherein one end portion of the metal foil (6) is connected to the disk and the other end of the metal foil (6) is electrically connected to an outer lead (9),

wherein an end portion of the inner lead (3) on the other end side protrudes from an end surface of the disk (5),

wherein a metal body (M) is disposed between the glass member (7) and the disk (5), and the metal body (M) includes an inserted portion (K, K2) into which the end portion of the inner lead (3) is inserted, and

wherein a protrusion length (L1) of the inner lead (3) protruding from the end surface of the disk (5) is smaller than a length (L2) of the inserted portion (K, K2) in the protrusion direction of the inner lead (3).

[0015]

According to a second aspect of the present invention, the metal body (M) is formed by laminating a plurality of annular metal foils (Ma) each having a through hole (P) formed at the center thereof, and the inserted portion (K, K2) is a communication hole which is formed by overlapping the respective through holes (P).

[0016]

According to a third aspect of the present invention, the metal body (M) is a

metal foil including a flat portion (Mb1) and a bent portion (Mb2) which is formed by bending a peripheral portion of the flat portion in a direction toward the disk, and the inserted portion (K, K2) is a concave portion which is formed by a bottom surface of the flat portion and an inner edge of the bent portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1 is an explanatory view showing a discharge lamp according to an exemplary embodiment of the invention;

Fig. 2 is an enlarged cross-sectional view only showing a glass member, a metal body, a disk, and an inner lead of the discharge lamp according to the exemplary embodiment;

Fig. 3 is an enlarged cross-sectional view only showing the glass member, the metal body, the disk, and the inner lead of the discharge lamp according to the exemplary embodiment;

Fig. 4 is a perspective view only showing a metal foil forming the metal body shown in Fig. 3;

Fig. 5 is an enlarged cross-sectional view only showing the glass member, the metal body, the disk, and the inner lead of the discharge lamp according to the exemplary embodiment;

Fig. 6 is an enlarged cross-sectional view only showing the glass member, the metal body, the disk, and the inner lead of the discharge lamp according to another exemplary embodiment of the invention;

Fig. 7 is an explanatory view showing a discharge lamp in the related-art;

Figs. 8A and 8B are perspective views only showing the metal foil of the

discharge lamp shown in Fig. 7; and

Fig. 9 is an explanatory view showing a structural relationship between the disk and the inner lead.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0018]

Exemplary embodiments of the present invention will be now described with reference to the drawings.

Fig. 1 is a cross-sectional view showing a discharge lamp according to the exemplary embodiment.

Reference numeral 1 denotes a discharge container which includes a light emitting tube 11 and a sealing tube 12 which is connected to the light emitting tube 11. An electrode 2 is disposed inside the light emitting tube 11 of the discharge container 1, and the electrode 2 is provided to the front end portion of an inner lead 3 which extends to the inside of the light emitting tube 11. The inner lead 3 may be formed in a rod shape. Also, the inner lead 3 is inserted into a through hole of a glass holding cylinder body 4, and held in the sealing tube 12. The holding cylinder body 4 is disposed between the outer periphery of the inner lead 3 and the inner periphery of the sealing tube 12.

The rear end portion of the inner lead 3 on the opposite side of the electrode 2 is inserted through a through hole formed at the center of a disk 5, and welded to the disk 5. The disk 5 is formed of metal such as molybdenum having a high melting point.

[0019]

A cylindrical glass member 7 is disposed inside the sealing tube 11. The disk 5 is disposed inside the sealing tube 12 so as to face the end surface of the glass member 7

on the side of the light emitting tube 11. A surface of the glass member 7 facing the disk 5 is formed in a flat surface shape. A surface of the disk 5 on the side of the light emitting tube 11 is welded to one end of a metal foil 6. The metal foil 6 is formed to extend in an axial direction along the outer periphery of the cylindrical glass member 7. For example, five sheets of metal foils 6 are formed on the outer periphery of the cylindrical glass member 7 so as to be spaced from each other, the other side of the metal foil 6 welded to the disk 5 is welded to a metal member 8 which is formed in a plate shape, and each of the metal foils 6 is electrically connected to an outer lead 9 via the metal member 8. In addition, one end of the metal foil 6 may be welded to the side surface of the disk 5.

[0020]

The outer lead 9 is held by a glass holding cylinder body 41 for holding the outer lead 9. Also, the outer lead 9 passes through the metal member 8 so as to be welded to the metal member 8 and to be inserted into a hole 71 formed in the glass member 7. The outer lead 9 may be formed in a rod shape.

[0021]

In addition, a metal body M is disposed between the glass member 7 and the disk 5. A metal foil M2 formed of molybdenum is disposed between the disk 5 and the holding cylinder body 4 for holding the inner lead 3.

The metal body M will be described in detail later.

As shown in Fig. 8B, the metal foil M2 is an annular metal foil in which a through hole is formed at the center thereof so as to allow the inner lead 3 to be inserted therein, and has almost the same diameter as that of the disk 5.

Further, since the other-side sealing tube has the same structure, the description thereof will be omitted herein.

Furthermore, depending on the type of the lamp, the metal foil M2 may not be disposed between the holding cylinder body 4 and the disk 5.

[0022]

Next, the function of the metal body M will be described in detail. Fig. 2 is an enlarged cross-sectional view only showing the glass member, the metal body, the disk, and the inner lead. As shown in Fig. 2, the metal body M is disposed between the glass member 7 and the disk 5. The metal body M has an outer diameter of about 10 mm, for example. The outer diameter of the metal body M is substantially the same as that of the disk 5 and that of the glass member 7 on the side of the disk 5. The metal body M has a through hole P therethrough. The thorough hole P is formed at the center of the metal body M so as to have an inner diameter of about 5 mm, which is larger than an outer diameter of the rear end portion 3a of the inner lead 3. The metal body M is one sheet of metal foil made of molybdenum and having a thickness of about 0.05 mm.

[0023]

As shown in Fig. 2, it is difficult to align a rear end portion 3a of the inner lead 3 with an end surface 5a of the disk 5, and thus the rear end portion 3a slightly protrudes from the end surface 5a. A protrusion length L1 of the rear end portion 3a protruding from the end surface 5a may be about 0.033 mm. Furthermore, a length L2 of a hole K provided in the metal body M in the protrusion direction of the rear end portion 3a may be about 0.05 mm. Also, the length L2 is a thickness of one sheet of metal foil M. That is, the protrusion length L1 and the length L2 satisfy the relationship of $L1 < L2$.

[0024]

As a result, when a heating process using a burner or the like is performed on the outside of the sealing tube 12 and the glass member 7 is welded to the sealing tube 12, since the metal body M is provided between the glass member 7 and the disk 5, it is

possible to completely separate the glass member 7 from the disk 5 by using the metal body M so as not to come into contact with each other. Also, even when the rear end portion 3a of the inner lead 3 protrudes from the end surface 5a of the disk 5, the rear end portion 3a does not come into contact with the glass member 7. Accordingly, it is possible to prevent the sealing tube from being broken by preventing a crack from being generated in the glass member 7. Also, it is possible to prevent gas from leaking from the light emitting tube. Therefore, it is possible to obtain the discharge lamp having a long durability.

In addition, in a combination of the metal body M, the disk 5, and the glass member 7, for example, the same advantage can be obtained from a combination in which the outer diameters of the metal body M and the disk 5 and the diameter of the end surface of the glass member 7 on the side of the disk 5 are substantially the same and set to about 15 mm, and the inner diameter of the through hole of the metal body M is set to about 6 mm. In addition, the same advantage can be obtained from, for example, a combination in which the outer diameters of the metal body M and the disk 5 and the diameter of the glass member 7 on the side of the disk 5 are substantially the same and set to about 30 mm, and the inner diameter of the through hole of the metal body M is set to about 6 mm.

[0025]

Fig. 3 is an enlarged cross-sectional view only showing the glass member 7, the metal body M, the disk 5, and the inner lead 3 of the discharge lamp according to another exemplary embodiment of the present invention. Fig. 4 is a perspective view only showing the metal foil Ma forming the metal body M shown in Fig. 3.

As shown in Fig. 3, the metal body M is disposed between the glass member 7 and the disk 5. The metal body M has a hole K which is formed at the center thereof so

as to allow the rear end portion 3a of the inner lead 3 protruding from the end surface 5a of the disk 5 to be inserted therein.

The metal body M has a laminated structure in which three sheets of annular metal foils Ma having a through hole P at the center are laminated as shown in Fig. 4.

The disk 5 is a metal plate formed of molybdenum. The disk 5 has a thickness of about 2 mm and an outer diameter of about 10 mm, and a through hole having an inner diameter of about 5 mm is formed at the center of the disk 5 so as to communicate with the inner lead 3.

As shown in Fig. 4, the metal foil Ma has an outer diameter of about 10 mm, which is substantially the same as an outer diameter of the disk 5 and a diameter of the end surface of the glass member 7 on the side of the disk 5. The through hole P having an inner diameter of about 5 mm is formed at the center of the metal foil Ma. The metal foil Ma is formed of molybdenum, and has a thickness of about 0.015 mm.

As shown in Fig. 3, according to the metal body M, the through holes P of three sheets of metal foils Ma overlap with each other so as to form a communication hole, and the communication hole serves as the hole K provided in the metal body M.

[0026]

Further, it is difficult to align the end surface 5a of the disk 5 with the rear end portion 3a of the inner lead 3, and thus the rear end portion 3a slightly protrudes from the end surface 5a. A protrusion length L1 of the rear end portion 3a protruding from the end surface 5a may be about 0.033 mm. Furthermore, a length L2 of the hole K provided in the metal body M in the protrusion direction of the rear end portion 3a may be about 0.045 mm.

For the description, Fig. 3 shows a state that the gap is formed between the respective metal foils Ma. However, actually, the respective metal foils Ma come into

contact with each other without a gap. The length $L2$ is equal to the total thickness of three sheets of metal foils Ma . That is, the protrusion length $L1$ and the length $L2$ satisfy the relationship of $L1 < L2$.

[0027]

As a result, when a heating process using a burner or the like is performed on the outside of the sealing tube 12 and the glass member 7 is welded to the sealing tube 12, since the metal body M is provided between the glass member 7 and the disk 5, it is possible to completely separate the glass member 7 from the disk 5 by using the metal body M so as not to come into contact with each other. Also, even when the rear end portion 3a of the inner lead 3 protrudes from the end surface 5a of the disk 5, the rear end portion 3a does not come into contact with the glass member 7. Accordingly, it is possible to prevent the sealing tube from being broken by preventing a crack from being generated in the glass member 7. Also, it is possible to prevent gas from leaking from the light emitting tube. Therefore, it is possible to obtain the discharge lamp having a long durability.

[0028]

In the above-described exemplary embodiment, the metal body M has a laminated structure in which three sheets of metal foils Ma having the through hole P are laminated. However, the number of laminated sheets of the metal foils Ma may be appropriately changed depending on the length of the inner lead 3 protruding from the end surface 5a.

[0029]

Fig. 5 is an enlarged cross-sectional view only showing the glass member 7, the metal body M , the disk 5, and the inner lead 3 in the case of using the metal body M according to another exemplary embodiment.

In the structure shown in Fig. 5, the length L2 of the hole K provided in the metal body M in the protrusion direction of the inner lead 3 is longer than the length L1 of the inner lead 3 protruding from the end surface 5a of the disk 5. Here, a disc-shaped metal foil M1 having no through hole (shown in Fig. 8A) is disposed on a side of the metal foil Ma, which is the closest to the disk 5 among the plural metal foils Ma..

According to the discharge lamp with such a configuration, in performing a heating process on the sealing tube, the metal foil M1 having no through hole is deformed by the rear end portion 3a so as to enter the gap K.

However, since the relationship $L1 < L2$ is satisfied, it is possible to reliably obtain a structure in which the rear end portion 3a does not come into contact with the glass member 7 even when the metal foil M1 having no through hole is deformed. Thus, a crack can be prevented from being generated in the glass member 7.

[0030]

In addition, although not shown in the drawing, when the disc-shaped metal foil M1 having no through hole (shown in Fig 8A) is disposed between the metal foils Ma shown in Fig. 3, the metal foil M1 having no through hole is deformed by the rear end portion 3a so as to enter the gap K in performing a heating process on the sealing tube. However, since the total thickness L2 (in this case, the thickness is equal to the length L2 of the hole K) of the metal body Ma is larger than the length L1 of the inner lead 3 protruding from the end surface 5a, it is possible to reliably obtain a structure in which the rear end portion 3a does not come into contact with the glass member 7. Thus, it is possible to prevent a crack from being generated in the glass member 7.

[0031]

Fig. 6 is an enlarged cross-sectional view only showing the glass member 7, the metal body M, the disk 5, and the inner lead 3 of the discharge lamp according to

another exemplary embodiment of the invention.

As shown in Fig. 6, the metal body M is provided between the glass member 7 and the disk 5, and the metal body M is formed by bending the peripheral portion of one sheet of metal foil Mb.

The disk 5 is formed of molybdenum and has a thickness of about 2 mm and an outer diameter of about 10 mm. A through hole having an inner diameter of about 5 mm is formed at the center thereof so as to communicate with the inner lead 3. A diameter of the end surface of the glass member 7 on the side of the disk 5 is about 10 mm.

The metal foil Mb includes a flat portion Mb1 and a bent portion Mb2 formed by bending the peripheral portion of the flat portion Mb1 in a direction toward the disk 5. A concave portion K2 is formed by a surface Mb10 of the flat portion Mb1 on the side of the inner lead 3 and an inner edge Mb20 of the bent portion Mb2. The rear end portion 3a of the inner lead 3 protruding from the end surface 5a of the disk 5 is inserted into the concave portion K2. The metal foil Mb has a thickness of about 0.10 mm and an outer diameter of about 10 mm, and an opening diameter of the inner edge Mb20 of the bent portion Mb2 is about 7 mm.

[0032]

As shown in Fig. 6, when a protrusion length L1 of the inner lead 3 protruding from the end surface 5a of the disk 5 is about 0.033 mm. Furthermore, a length L2 of a concave portion K2 is about 0.045 mm. In this embodiment, the length L2 is a length from the surface Mb10 of the flat portion Mb1 to the front end of the inner edge Mb20 of the bent portion Mb2 on the side of the disk 5. That is, the protrusion length L1 and the length L2 satisfy the relationship of $L1 < L2$.

As a result, even when the inner lead 3 protrudes from the end surface 5a of the disk 5, the protrusion portion of the inner lead 3 is inserted into the concave portion K2

of the metal foil Mb, and the rear end portion 3a does not come into contact with the glass member 7.

[0033]

As a result, when a heating process using a burner or the like is performed on the outside of the sealing tube 12 and the glass member 7 is welded to the sealing tube 12, since the metal body M is provided between the glass member 7 and the disk 5, it is possible to completely separate the glass member 7 from the disk 5 by using the metal body M so as not to come into contact with each other. Also, even when the rear end portion 3a of the inner lead 3 protrudes from the end surface 5a of the disk 5, the rear end portion 3a does not come into contact with the glass member 7. Accordingly, it is possible to prevent the sealing tube from being broken by preventing a crack from being generated in the glass member 7. Also, it is possible to prevent gas from leaking from the light emitting tube. Therefore, it is possible to obtain the long durable discharge lamp.

[0034]

While the present invention has been shown and described with reference to certain exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims. It is aimed, therefore, to cover in the appended claim all such changes and modifications as fall within the true spirit and scope of the present invention.

WHAT IS CLAIMED IS:

1. A discharge lamp comprising:

a light emitting tube (11);

a sealing tube (12) connected to an end portion of the light emitting tube;

a cylindrical glass member (7) disposed inside the sealing tube;

a metallic disk (5) having a through hole therein and disposed inside the sealing tube so as to face an end surface of the cylindrical glass member on the side of the light emitting tube;

an inner lead (3) formed in a rod shape, wherein one end side of the inner lead (3) extends to the inside of the light emitting tube and connected to an electrode (2), and the other end side of the inner lead (3) is inserted through the thorough hole of the disk and fixed to the disk;

a glass holding cylinder body (4) disposed between the outer periphery of the inner lead and the inner periphery of the sealing tube so as to hold the inner lead; and

a metal foil (6) extending along the outer periphery of the glass member, wherein one end portion of the metal foil (6) is connected to the disk and the other end of the metal foil (6) is electrically connected to an outer lead (9),

wherein an end portion of the inner lead (3) on the other end side protrudes from an end surface of the disk (5),

wherein a metal body (M) is disposed between the glass member (7) and the disk (5), and the metal body (M) includes an inserted portion (K, K2) into which the end portion of the inner lead (3) is inserted, and

wherein a protrusion length (L1) of the inner lead (3) protruding from the end surface of the disk (5) is smaller than a length (L2) of the inserted portion (K, K2) in the

protrusion direction of the inner lead (3).

2. The discharge lamp according to claim 1,

wherein the metal body (M) is formed by laminating a plurality of annular metal foils (Ma) each having a through hole (P) formed at the center thereof, and

wherein the inserted portion (K, K2) is a communication hole which is formed by overlapping the respective through holes (P).

3. The discharge lamp according to claim 1,

wherein the metal body (M) is a metal foil including a flat portion (Mb1) and a bent portion (Mb2) which is formed by bending a peripheral portion of the flat portion in a direction toward the disk, and

wherein the inserted portion (K, K2) is a concave portion which is formed by a bottom surface of the flat portion and an inner edge of the bent portion.