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(54) Electrodeless high-pressure discharge lamp

Elektrodenlose Hochdruckentladungslampe

Lampe à décharge à haute pression sans électrodes

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(56) References cited:
EP-A- 0 440 381
EP-A- 0 449 640
US-A- 5 047 893

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Description

The invention relates to a electrodeless high-pressure discharge lamp comprising:

a light-transmitting lamp vessel which is closed in a vacuumtight manner and which has a ionizable filling;
around the lamp vessel, an electric coil with end portions which are electrically connected to a neutral electric lead extending away from the coil and to a live electric lead, respectively, which leads are to be connected to an electric supply,
the electric leads being connected to a heat sink.

Such an electrodeless high-pressure discharge lamp is known from EP-A-0,440,381.

Heat generated by current passage through the electric leads or through the coil and heat radiated by the discharge vessel towards the coil render it necessary to cool the leads so as to prevent the supply assuming a too high temperature. The coil should also be prevented from assuming a comparatively high temperature, and thus a comparatively high electrical resistance. A higher electrical resistance would cause the ohmic losses to increase, and thus also the temperature.
In the known lamp, cooling is realised in that a heat sink is fastened against each of the two electric leads. Heat is thus removed from these leads through the heat sinks to the surroundings.

Metals are highly suitable, being good thermal conductors, for forming heat sinks and any fins thereof. Since only one of the two electric leads can be connected to earth, while the other one is live, the heat sink of this other electric lead is live. This is a safety hazard of the known lamp.

In the known lamp, a dielectric is accommodated between the electric leads so as to form a capacitance C_p in parallel to the coil. Dielectrics which can be used are polytetrafluoroethene, mica and polyimide. The said capacitance C_p renders it possible in conjunction with another capacitance C_s connected in series with the coil elsewhere to adapt the impedance of the load, consisting of the coil and the discharge, to the electric supply.

A similar electrodeless high-pressure discharge lamp is also known from US-A-5,030,889.

US-A-5,039,903 and US-A-5,042,139 disclose electrodeless high-pressure discharge lamps in which each of the ends of the electric coil is connected to a ballast *via* a respective heat sink, and the electric leads extend at a distance from these heat sinks. It is also possible to circulate water through the coils in these lamps in order to cool the coils. A drawback of this is that lines, a drive and energy consumption are necessary for this purpose.

US-A-4,910,439 discloses an electrodeless high-pressure discharge lamp in which a forced air current cools the electric coil. This lamp has the drawback that a motor and lines are necessary for cooling, and also that energy is required for this purpose.

It is an object of the invention to provide an electrodeless high-pressure discharge lamp of the kind described in the opening paragraph which has an improved safety as regards inadvertent touching of electrical parts and which comprises reliable means for cooling the electric coil and the electric leads.

According to the invention, this object is achieved in that the live electric lead is electrically insulated from the heat sink by aluminium nitride.

Aluminium nitride combines a comparatively high electrical resistivity of approximately 10^{12} Ωm with a comparatively high thermal conductivity of approximately 150 $Wm^{-1}K^{-1}$. This means that it is highly suitable for connecting a live electric lead thermally, but not electrically, to an electrically conducting body.

In an embodiment of the electrodeless high-pressure discharge lamp according to the invention, the live lead is in physical, and thus in thermal contact with the neutral lead through interposition of aluminium nitride, while the neutral lead is in contact with the heat sink. The live lead then transfers heat through the aluminium nitride and the neutral lead transfers heat to the heat sink and thus to the surroundings. The heat sink may in this case surround the two leads entirely or substantially, however, surrounding the live lead at a distance, possibly with the interposition of an electric insulator such as, for example, aluminium nitride.

An advantage of this embodiment is that a parallel capacitance C_p is provided across the coil with the aluminium nitride as a dielectric. The value of this capacitance to be set, however, imposes limitations on the geometry of the leads and of the interposed aluminium nitride.

In alternative embodiments, a parallel capacitance C_p across the coil may be incorporated at a greater distance from the coil, for example, in the electric supply. In such an embodiment, each of the electric leads may have its own heat sink, the live lead being connected to its heat sink *via* aluminium nitride, for example, in that the two portions of a two-part heat sink are pulled towards one another with the interposition of a respective body made of aluminium nitride between a heat sink portion and the live lead. In a modification thereof, however, the heat sink of the live lead is integral with the heat sink of the neutral lead.

In an embodiment which is convenient as regards construction and dimensioning, the two electric leads are together surrounded by a heat sink which is in contact both with the live lead and with the neutral lead *via* aluminium nitride. In this case portions of the - for example two-part - heat sink may be pulled both against the neutral lead and against the live lead with the interposition of aluminium nitride each time.

The electrodeless high-pressure discharge lamp according to the invention renders possible a compact

shape in which the use of a fluid such as air or water, and of circulating means for this purpose is dispensed with. Ohmic losses and damage to the electric supply to be used are nevertheless effectively counteracted.

Embodiments of the electrodeless high-pressure discharge lamp according to the invention are shown in the drawing, in which

Fig. 1 shows a lamp in perspective view, partly broken away;
Fig. 2 is a diagrammatic cross-section taken on the line II-II in Fig. 1;
Fig. 3 shows an alternative embodiment in the same manner as in Fig. 2;
Fig. 4 shows a modification of Fig. 3; and
Fig. 5 shows a further embodiment in the same manner as in Fig. 2.

In Fig. 1, the electrodeless high-pressure discharge lamp has a light-transmitting lamp vessel 1, made of quartz glass in the Figure and having a volume of 2 cm^3, which is closed in a vacuumtight manner and which has a ionizable filling of 2.5 mg NaI, 1.5 mg CeI_3 and 125 mbar Xe. Alternatively, however, the lamp vessel may be made of ceramic material, for example, monocrystalline or polycrystalline ceramic material such as sapphire or sintered aluminium oxide. An electric coil 2, for example made of copper, is present around the lamp vessel, with three turns in the Figure, which coil has end portions 3, 4 which are electrically connected to a neutral electric lead 5 which extends away from the coil and to a live electric lead 6, respectively. These leads, made of copper in the Figure, are to be connected to an electric supply. The electric leads 5, 6 are connected to a heat sink 7.

The live lead 6 (see Fig. 2) is electrically insulated from the heat sink 7 by aluminium nitride 8. The live lead 6 is in contact with the neutral lead 5 through the interposed aluminium nitride 8, and the neutral lead in its turn is in contact with the heat sink 7.

The lamp shown has a luminous efficacy of 100 lm/W at a consumed power of 160 W. The lamp vessel 1 is accommodated in a reflector 9 which is closed off by a grid 10 of metal wire. The heat sink 7 has fins 11 for an improved heat transfer to the surroundings.

The two leads 5, 6 together with the aluminium nitride 8 form a capacitance C_p which is in parallel to the coil 2 and which together with a capacitance C_s connected in series elsewhere adapts the coil and the discharge to their supply unit.

In Fig. 3 and subsequent Figures, corresponding parts are always given the same reference numerals.

In Fig. 3, each of the electric leads 5, 6 has its own heat sink 7, 17, and the live lead 6 is in physical contact with aluminium nitride 8 which is in physical contact with the heat sink 17 of the live lead. A capacitance C_p is connected in parallel to the discharge and the coil elsewhere.

In Fig. 4, the heat sink of the live lead 6 is integral with the heat sink 7 of the neutral lead 5.

The two electric leads 5, 6 in the embodiment of Fig. 5 are together surrounded by a heat sink 7 which is in contact both with the live lead 6 and with the neutral lead 5 *via* aluminium nitride 8. The heat sink 7 is mounted on a metal support plate 12.

Claims

1. An electrodeless high-pressure discharge lamp comprising:

   a light-transmitting lamp vessel (1) which is closed in a vacuumtight manner and which has a ionizable filling;
   around the lamp vessel, an electric coil (2) with end portions (3, 4) which are electrically connected to a neutral electric lead (5) extending away from the coil (2) and to a live electric lead (6), respectively, which leads (5, 6) are to be connected to an electric supply,
   the electric leads being connected to a heat sink (7),

   characterized in that the live electric lead (6) is electrically insulated from the heat sink (7) by aluminium nitride (8).

2. An electrodeless high-pressure discharge lamp as claimed in Claim 1, characterized in that the live lead (6) is in contact with the neutral lead (5) through interposition of aluminium nitride (8), while the neutral lead (5) is in contact with the heat sink (7).

3. An electrodeless high-pressure discharge lamp as claimed in Claim 1, characterized in that each of the electric leads (5, 6) has its own heat sink (7, 17), and the live lead (6) is in contact with aluminium nitride (8), which is in contact with the heat sink (17) of the live lead (6).

4. An electrodeless high-pressure discharge lamp as claimed in Claim 3, characterized in that the heat sink (17) of the live lead (6) is integral with the heat sink (7) of the neutral lead (5).

5. An electrodeless high-pressure discharge lamp as claimed in Claim 1, characterized in that the two electric leads (5, 6) are together surrounded by a heat sink (7) which is in contact both with the live lead (6) and with the neutral lead (5) *via* aluminium nitride (8).

Patentansprüche

1. Elektrodenlose Hochdruck-Entladungslampe mit:

einem vakuumdicht verschlossenen Lampengefäß (1), das eine ionisierbare Füllung hat;
um das Lampengefäß herum, einer elektrischen Spule (2) mit Endabschnitten (3, 4), die mit einem von der Spule (2) weg verlaufenden elektrischen Nulleiter (5) und mit einem spannungführenden elektrischen Leiter (6) elektrisch verbunden sind, welche Leiter (5,6) an eine elektrische Versorgung angeschlossen werden sollen,
wobei die elektrischen Leiter mit einem Kühlkörper (7) verbunden sind,

dadurch gekennzeichnet, daß der spannungführende elektrische Leiter (6) von dem Kühlkörper (7) durch Aluminiumnitrid (8) elektrisch isoliert ist.

2. Elektrodenlose Hochdruck-Entladungslampe nach Anspruch 1, dadurch gekennzeichnet, daß der spannungführende Leiter (6) durch Zwischenfügen von Aluminiumnitrid (8) in Kontakt mit dem Nulleiter (5) steht, während der Nulleiter (5) mit dem Kühlkörper (7) in Kontakt steht.

3. Elektrodenlose Hochdruck-Entladungslampe nach Anspruch 1, dadurch gekennzeichnet, daß jeder der elektrischen Leiter (5, 6) seinen eigenen Kühlkörper (7, 17) hat und der spannungführende Leiter (6) mit Aluminiumnitrid (8) in Kontakt steht, das mit dem Kühlkörper (17) des spannungführenden Leiters (6) in Kontakt steht.

4. Elektrodenlose Hochdruck-Entladungslampe nach Anspruch 3, dadurch gekennzeichnet, daß der Kühlkörper (17) des spannungführenden Leiters (6) mit dem Kühlkörper (7) des Nulleiters (5) ein einziges Teil bildet.

5. Elektrodenlose Hochdruck-Entladungslampe nach Anspruch 1, dadurch gekennzeichnet, daß die beiden elektrischen Leiter (5, 6) zusammen von einem Kühlkörper (7) umgeben sind, der über Aluminiumnitrid (8) sowohl mit dem spannungführenden Leiter (6) als auch mit dem Nulleiter (5) in Kontakt steht.

Revendications

1. Lampe à décharge à haute pression sans électrodes comportant:

un récipient de lampe transmettant la lumière (1) qui est fermé d'une manière étanche au vide et qui présente un remplissage ionisable;
autour du récipient de lampe une bobine électrique (2) présentant des parties terminales (3, 4) qui sont reliées électriquement à un conducteur électrique neutre (5) s'éloignant de la bobine (2) respectivement à un conducteur électrique sous tension (6), lesdits conducteurs (5, 6) doivent être reliés à une alimentation électrique,
les conducteurs électriques étant reliés à une lame de refroidissement (7),

caractérisée en ce que le conducteur électrique sous tension (6) est isolé électriquement de la lame de refroidissement (7) par l'azoture d'aluminium (8).

2. Lampe à décharge à haute pression sans électrodes selon la revendication 1, caractérisée en ce que le conducteur sous tension (6) est en contact avec le conducteur neutre (5) par l'interposition d'azoture d'aluminium (8), alors que le conducteur neutre (5) est en contact avec la lame de refroidissement (7).

3. Lampe à décharge à haute pression sans électrodes selon la revendication 1, caractérisée en ce que chacun des conducteurs électriques (5, 6) présente sa propre lame de refroidissement (7, 17) et en ce que le conducteur sous tension (6) est en contact avec l'azoture d'aluminium (8) qui est en contact avec la lame de refroidissement (17) du conducteur sous tension (6).

4. Lampe à décharge à haute pression sans électrodes selon la revendication 3, caractérisée en ce que la lame de refroidissement (17) du conducteur sous tension (6) fait corps avec la lame de refroidissement (7) du conducteur neutre (5).

5. Lampe à décharge à haute pression sans électrodes selon la revendication 1, caractérisée en ce que les deux conducteurs (5, 6) sont entourés conjointement d'une lame de refroidissement (7) qui est en contact avec le conducteur sous tension (6) aussi bien qu'avec le conducteur neutre (5) par l'intermédiaire de l'azoture d'aluminium (8).

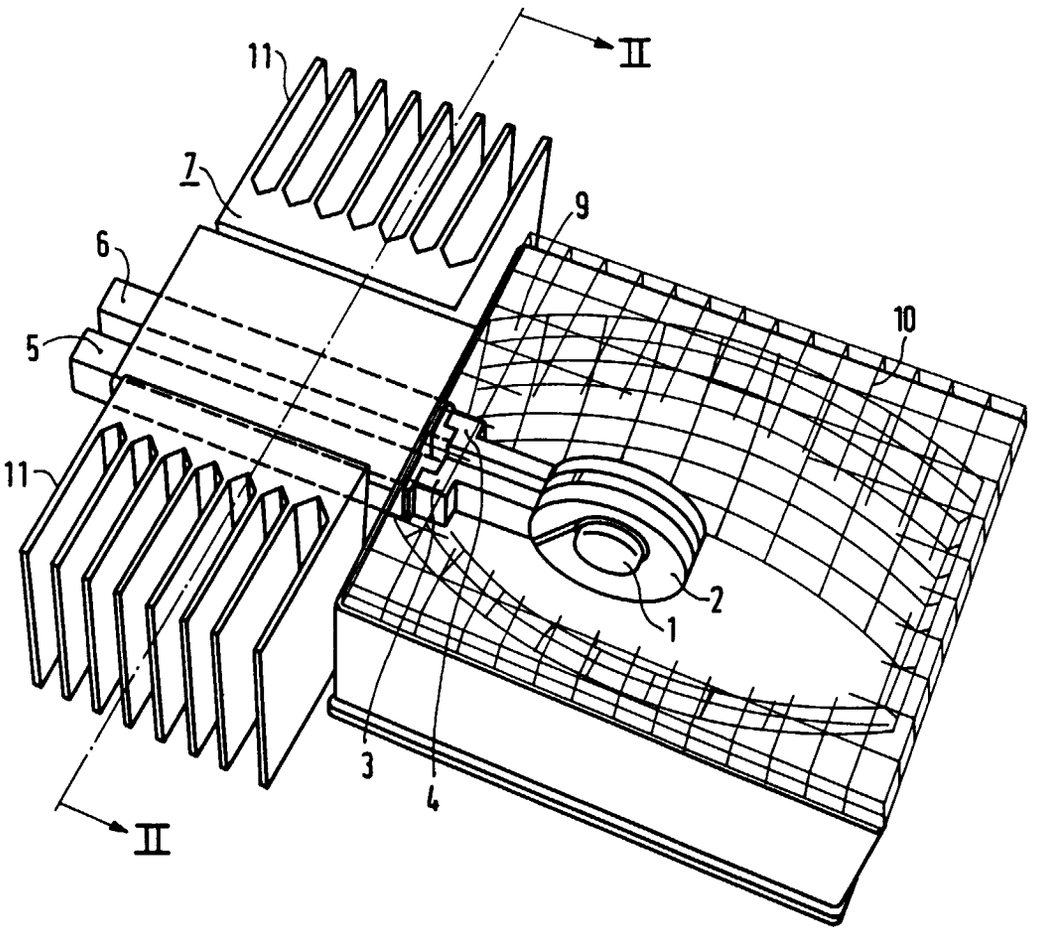


FIG.1

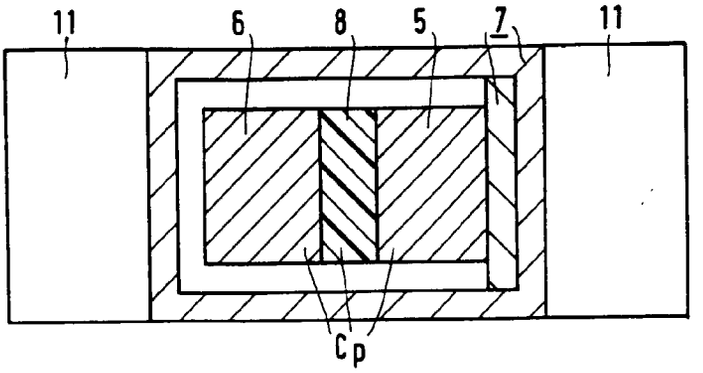


FIG.2

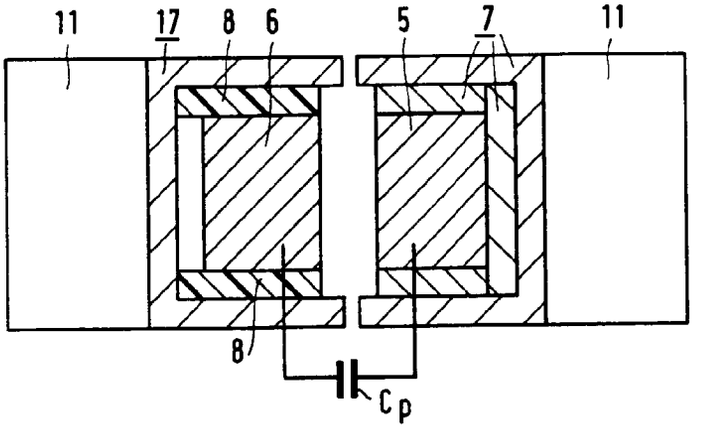


FIG.3

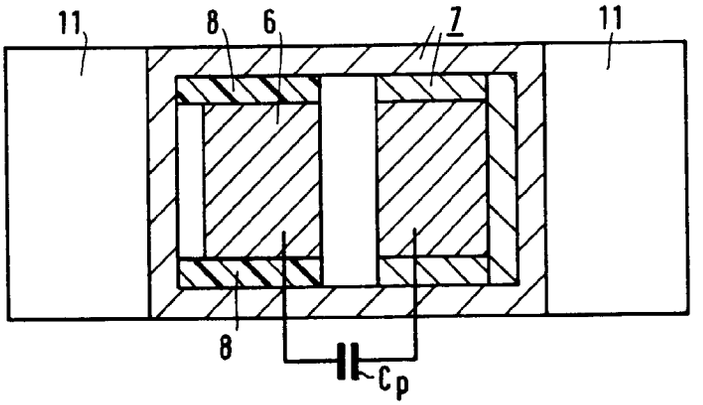


FIG.4

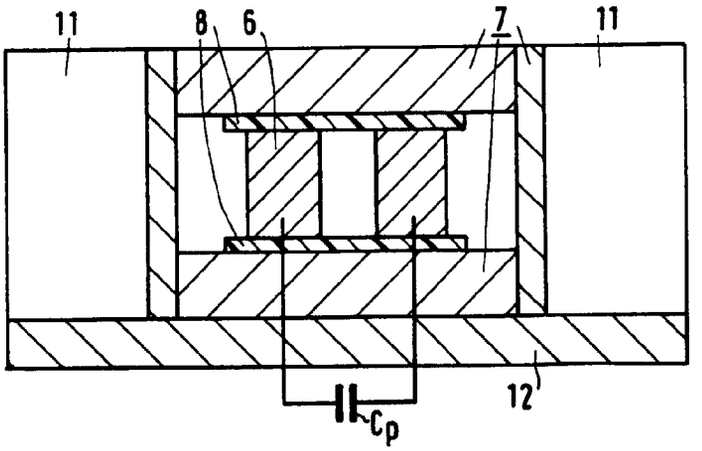


FIG.5