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(54) **Vehicle headlamp**

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(56) References cited:
EP-A2- 2 000 447 WO-A1-2007/104193
JP-A- 7 114 807 JP-A- 2005 203 309
JP-A- 2006 100 089 JP-A- 2007 188 758
US-A1- 2006 171 162 US-A1- 2008 211 411

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Description

BACKGROUND OF THE INVENTION

<FIELD OF THE INVENTION>

[0001] The present invention relates to a headlamp for use in a vehicle. Specifically, the invention relates to technology in which a ceramic arc tube is inclined in the horizontal direction to thereby secure the maximum radiance of a high level.

<BACKGROUND ART>

[0002] As a headlamp for use in a vehicle (which is hereinafter referred to as a vehicle headlamp), there are several types, for example, a type in which an incandescent lamp (an incandescent bulb) or a halogen lamp (a halogen bulb) is used as a light source, and a type in which a discharge lamp (a discharge bulb) is used as a light source.

[0003] In the vehicle headlamp of a type using an incandescent lamp or a halogen lamp as a light source, a filament of the incandescent lamp or halogen lamp substantially uniformly emits light to provide a rod-like light emitting portion. Owing to this, when such vehicle headlamp is used as a reflection type lamp using a reflector or the like, there is an advantage that a control of a light distribution according to a shape of a reflecting surface of the reflector is easy.

[0004] On the other hand, in the vehicle headlamp of a type using a discharge lamp as a light source, the discharge lamp can provide a larger quantity of light than the incandescent lamp and halogen lamp and thus can enhance the radiance thereof. Also, the discharge lamp has another advantage that it has a longer life than the incandescent lamp and halogen lamp.

[0005] Since the discharge lamp has higher radiance and longer life than the incandescent lamp and halogen lamp, a vehicle headlamp of a type including the discharge lamp becomes widely used.

[0006] Some discharge lamp is structured in the following manner. That is, it includes a ceramic arc tube disposed within an outer tube. The ceramic arc tube is used to hold a pair of electrodes and also contains a gas such as an inert gas enclosed therein. The ceramic arc tube includes a light emitting portion, within which discharge is carried out, and a pair of fine tube portions respectively disposed on the mutually opposite sides with the light emitting portion between them. The light emitting portion is a portion in which an arc is generated when the discharge is carried out and also which is formed larger in diameter than the fine tube portions.

[0007] In the discharge lamp, a given starting voltage is applied to the pair of electrodes held by the ceramic arc tube and the discharge of the ceramic arc tube is executed in the light emitting portion, whereby the discharge lamp is started to turn ON.

[0008] As a discharge lamp, there is known a discharge lamp in which the ceramic arc tube includes first and second portions connected together and a central portion of the light emitting portion is used as the connecting portion between the first and second portions (see, for example, EP2000447A2).

[0009] It is difficult to form the ceramic arc tube as an integral body while securing the stability of the shape. Thus, as described above, there is widely used a method in which the two portions are connected together to form the ceramic arc tube. Therefore, when the ceramic arc tube is formed by connecting together the two portions, the stability of the shape of the ceramic arc tube can be secured and also, due to the facilitated formation thereof, the manufacturing cost thereof can be reduced.

[0010] Further, if a ceramic arc tube does not have no connecting portion therein, since the central portion of the light emitting portion (the central portion between the pair of electrodes) provides the maximum radiance, it would be possible to secure the maximum radiance necessary to secure sufficient remote visibility.

[0011] However, in the conventional discharge lamp disclosed in EP2000947A2, since the connecting portion is formed in the central portion of the light emitting portion, the light is diffused by the connecting portion and the radiance of the light is thereby lowered. As a result, it becomes impossible to secure the maximum radiance of a necessary level.

[0012] JP 2007 188758 A relates to a vehicular headlight provided with a projection lens arranged on an optical axis, a light bulb and a reflector. JP 7 114807 A discloses a headlamp device for a vehicle including a reflecting mirror, a lamp body and a lamp. US 2006/0171162 A1 discloses a vehicle lamp with a light source, a reflector and a projection lens.

SUMMARY OF THE INVENTION

[0013] One or more embodiments of the present invention provide a vehicle headlamp which can secure the maximum radiance of a high level.

[0014] In accordance with one or more embodiment of the invention, a vehicle headlamp 1 is provided with: a discharge lamp 8 as a light source. The discharge lamp 8 is provided with: an outer tube 18 mounted on a socket 17; a ceramic arc tube 19 disposed within the outer tube 18 and including a light emitting portion 20, a first fine tube portion 21a that is continuous with the light emitting portion 20 at a first side of the light emitting portion 20, and a second fine tube portion 21b that is continuous with the light emitting portion 20 at a second side of the light emitting portion 20 which is opposite to said first side; and a pair of electrodes 24, 25 respectively disposed within the ceramic arc tube 19. The ceramic arc tube 19 is inclined with respect to the horizontal direction H.

[0015] Therefore, in the vehicle headlamp of the above structure, the discharge lamp is turned on in a state where

the ceramic arc tube is inclined with respect to the horizontal direction, whereby the light is emitted from the vehicle headlamp.

[0016] In the vehicle headlamp 1 of the above structure, the outer tube 18 further includes a tubular portion 18a1 having a cylindrical shape. A central axis of the cylindrical shape may be set on a first axis Ax1. Both a central axis of the first fine tube portion 21a and a central axis of the second fine tube portion 21b may be set on a second axis Ax2. The second axis Ax2 may be inclined with respect to the first axis Ax1.

[0017] In the vehicle headlamp 1 of the above structure, the first axis Ax1 be coincident with the horizontal direction H, when the vehicle headlamp 1 is mounted in a vehicle.

[0018] In the vehicle headlamp 1 of the above structure, a rear end of the outer tube 18 may be attached to the socket 17. The ceramic arc tube 19 may be inclined in a front side rising state where a front end of the ceramic arc tube 19 is situated upward.

[0019] In the vehicle headlamp 1 of the above structure, a rear end of the outer tube 18 may be attached to the socket 17, the ceramic arc tube 19 may be inclined in a front side falling state where a front end of the ceramic arc tube 19 is situated upward.

[0020] In the vehicle headlamp 1 of the above structure, the ceramic arc tube 19 may include a connecting portion 20a where a first portion 22 and a second portion 23 are connected together. The first portion 22 is defined by the first fine tube portion 21a and a portion of the light emitting portion 20. The second portion 23 is defined by the second fine tube portion 21b and the other remaining portions of the light emitting portion 20.

[0021] In the vehicle headlamp 1 of the above structure, the connecting portion 20a may be positioned nearer to the front end of the ceramic arc tube 19 than a center between the pair of electrodes 24, 25.

[0022] In the vehicle headlamp 1 of the above structure, the ceramic arc tube 19 may include a connecting portion 20a where a first portion 22 and a second portion 23 are connected together. The first portion 22 includes the first fine tube portion 21a and a portion of the light emitting portion 20. the second portion 23 includes the second fine tube portion 21b and the other remaining portions of the light emitting portion 20. A position of the connecting portion 20a in a direction of the second axis Ax2 may be shifted in the direction of the second axis Ax2 from a center between leading edges of the pair of electrodes 24, 25 in the direction of the second axis Ax2.

[0023] According to the vehicle headlamp of the above structure, the maximum radiance of a necessary level can be secured without being influenced by a diffusion of the light in the connecting portion and thus sufficient remote visibility can be secured.

[0024] If a direct current is supplied to the pair of electrodes to turn ON the discharge lamp and the ceramic arc tube is inclined with respect to the horizontal direction in the front side rising state, a drop in the temperature of

the cathode side with respect to the temperature of the anode side can be restricted. This can prevent the uneven distribution of the temperature of the ceramic arc tube and thus can enhance the light emitting efficiency of the vehicle headlamp.

[0025] If a position where the first and second portions are connected together is set nearer to the front end of the ceramic arc tube than the center between the pair of electrodes in the light emitting portion, the range of an area capable of securing the radiance of a high level can be spread, so that the formation of a necessary lighting pattern for the light emitted from the discharge lamp can be facilitated.

[0026] Other aspects and advantages of the invention will be apparent from the following description, the drawings and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

Fig. 1 is a schematic section view of a vehicle headlamp according to an exemplary embodiment of to the invention.

Fig. 2 is an enlarged side view, partially in section, of a discharge lamp.

Fig. 3 is a table of radiance depending on differences between inclination angles of a ceramic arc tube in AC turn-on operation of the discharge lamp.

Fig. 4 is a graphical representation to show distributions of radiance depending on differences between inclination angles of the ceramic arc tube in the AC turn-on operation of the discharge lamp.

Fig. 5 is a table of radiance depending on differences between inclination angles of a ceramic arc tube in DC turn-on operation of the discharge lamp.

Fig. 6 is a graphical representation to show the distributions of radiance depending on differences between the inclination angles of the ceramic arc tube in the DC turn-on operation of the discharge lamp.

Fig. 7 is an enlarged side view, partially in section, of a discharge lamp in which the position of a connecting portion is set forwardly of the center of a light emitting portion.

Fig. 8 is a graphical representation of the distribution of radiance provided by a discharge lamp in which the position of a connecting portion is set forwardly of the center of a light emitting portion.

Fig. 9 is a graphical representation of the distribution of radiance depending on differences between the inclination angles of a ceramic arc tube when the position of a connecting portion is set forwardly of the center of a light emitting portion.

Fig. 10 is a schematic section view of a vehicle headlamp in which the whole of a discharge lamp is inclined with respect to the horizontal direction.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0028] In a vehicle, headlamps are respectively disposed on right and left end portions of a front end portion of a vehicle body.

[0029] The vehicle headlamp 1, as shown in Fig. 1, includes a lamp housing 2 having a recessed portion opened up forwardly and a cover 3 for covering the opened surface of the lamp housing 2, while the lamp housing 2 and cover 3 cooperate together in constituting a lamp casing 4. The inner space of the lamp casing 4 is formed as a lamp chamber 5.

[0030] An insertion hole 2a is formed in a rear end portion of the lamp housing 2. The insertion hole 2a penetrates back and forth through the housing rear end portion. The insertion hole 2a is closed by a back cover 6. A disposition hole 2b is formed in a lower end portion of the lamp housing 2. The disposition hole 2b penetrates vertically through the housing lower end portion.

[0031] Within the lamp chamber 5, a reflector 7 is supported by an optical axis adjusting mechanism (not shown) in such a manner that it can be inclined. A mounting hole 7a is formed in a rear end portion of the reflector 7. The mounting hole 7a penetrates back and forth through the reflector rear end portion.

[0032] A discharge lamp 8 is mounted on the mounting hole 7a of the reflector 7.

[0033] A discharge lamp lighting device 9 is mounted on the disposition hole 2b of the lamp housing 2. This discharge lamp lighting device 9 is made of a lighting circuit (not shown) which is stored into an interior portion of a case member 10. An input side connector 11 is provided on an outer peripheral surface of the case member 10. An output side connector 12 is provided on the upper surface of the case member 10. The input side connector 11 is connected to a power supply circuit (not shown).

[0034] The output side connector 12 is connected to a starter device 14 through a feed cable 13. A connector 14a of the starter device 14 is connected to a socket (which will be discussed later) included in the discharge lamp 8.

[0035] To turn on the discharge lamp 8, a line voltage of the power supply circuit may be increased using the power supply circuit of the discharge lamp lighting device 9. For example, the line voltage may be DC converted to thereby provide a lighting voltage (starting voltage) which is a high ac voltage. This lighting voltage may be applied to the discharge lamp 8 through the feed cable 13 and starter device 14.

[0036] An extension 15 is provided in the lamp chamber 5. The extension 15 is used to shield some of composing parts disposed in the lamp chamber 5. A shade (not shown), for shielding a portion of the light to be emitted from the discharge lamp 8, is disposed in the lamp chamber 5.

[0037] The discharge lamp 8 is structured by connecting a main body 16 to a socket 17 (see Fig. 2).

[0038] The main body 16 includes an outer tube 18 and a ceramic arc tube 19 disposed within the outer tube 18. A rear end of the outer tube 18 is attached to the socket 17.

[0039] The outer tube 18 includes a closing portion 18a for covering the ceramic arc tube 19 and a holding portion 18b projected forwardly from a front end portion of the closing portion 18a. The outer tube 18 is made of, for example, quartz glass as an integral body. The closing portion 18a includes a tubular portion 18a1 having a cylindrical shape, a central axis of which is set on a first axis Ax1.

[0040] The ceramic arc tube 19 includes a light emitting portion 20 and two fine tube portions (first fine tube portion 21a and second fine tube portion 21b) respectively formed continuously with front and rear ends of the light emitting portion 20. The fine tube portions 21a and 21b are respectively formed to have substantially cylindrical shapes. Both of a central axis of the first fine tube portion 21a and a central axis of the second fine tube portion 21b are set on a second axis Ax2. Outside diameters of the fine tube portions 21a and 21b are set smaller than an outside diameter of the light emitting portion 20.

[0041] Into the light emitting portion 20, there are enclosed metal halides and inert gases such as xenon and argon.

[0042] The ceramic arc tube 19 is structured such that a first portion 22 and a second portion 23 are connected together. The first portion 22 is structured such that a forwardly situated fine tube portion 21a (the first fine tube portion 21a) and a forward portion of the light emitting portion 20 are formed as an integral body. The second portion 23 is structured such that a backwardly situated fine tube portion 21b (the second fine tube portion 21b) and a backward portion of the light emitting portion 20 are formed as an integral body.

[0043] In the ceramic arc tube 19, there is provided a connecting portion 20a which is formed by connecting together the first portion 22 and second portion 23. The connecting portion 20a has an uneven portion in its central portion in the back-and-forth direction of the light emitting portion 20.

[0044] The second axis Ax2 defining the central axes of the fine tube portions 21a, 21b is inclined with respect to the first axis Ax1 defining the central axis of the cylindrical shape of the tubular portion 18a1 of the outer tube 18. That is, when the vehicle headlamp 1 is mounted in a vehicle so that the first axis Ax1 coincident with the horizontal direction, the ceramic arc tube 19 is inclined with respect to the horizontal direction (in Figs. 1 and 2, which is shown by "H"). Further, in the embodiment of Fig. 2, the ceramic arc tube 19 is inclined in a front side rising state where its front end is situated upward. Here, the ceramic arc tube 19 may also be inclined with respect to the horizontal direction in a front side falling state where its leading end side is situated downward.

[0045] Within the fine tube portions 21a and 21b, there are respectively disposed a front electrode 24 and a rear

electrode 25 which are respectively formed long in the back-and-forth direction. A rear end portion 24a (a leading end 24a) of the front electrode 24 and a front end portion 25a (a leading end 25a) of the rear electrode 25 are respectively situated within the light emitting portion 20 of the outer tube 18.

[0046] A front end portion of the front electrode 24 is connected to a first lead wire 26. The first lead wire 26 penetrates from an interior portion of the ceramic arc tube 19 through the holding portion 18b of the outer tube 18. The first lead wire 26 is projected further forwardly, and the first lead wire 26 has a portion projected outwardly of the outer tube 18. The portion of the first lead wire 26, which is projected outwardly of the outer tube 18, is bent in a given direction and its rear end portion is connected to a first connecting terminal (not shown) which is provided in the socket 17.

[0047] The first lead wire 26 is held by the holding portion 18b of the outer tube 18. An insulating sleeve 27 is mounted on the portion that is projected outwardly of the outer tube 18, except for a portion thereof. The insulating sleeve 27 is made of, for example, insulating material such as glass or ceramic.

[0048] A rear end portion of the rear electrode 25 is connected to a second lead wire 28. The rear end portion of the second lead wire 28 is connected to a second connecting terminal (not shown) which is provided on the socket 17.

[0049] In the above-structured discharge lamp 8, when a lighting voltage (starting voltage) is applied through the feed cable 13 and the starter device 14 to the front electrode 24 and rear electrode 25, a discharge phenomenon is generated within the light emitting portion 20 of the ceramic arc tube 19 to thereby start to turn on the discharge lamp 8. Then, in the discharge lamp 8, since the ceramic arc tube 19 is inclined with respect to the horizontal direction H, a radiance of the light emitted from the light emitting portion 20 becomes the greatest (provides the maximum radiance) on the downwardly situated side of the light emitting portion 20.

[0050] Figs. 3 to 6 are tables or graphical representations to show variations in the radiance and the like of the ceramic arc tube 19 caused by differences between the angles of inclination of the ceramic arc tube 19. Measurements, which are shown in Figs. 3 to 6 when the ceramic arc tube 19 is inclined with respect to the horizontal direction H, are taken in such a manner that the inclination angle is set for 1°, 1.5°, 5°, 10°, 11° and 15°.

[0051] Figs. 3 and 4 respectively show the measured values obtained, in a state where an alternating current is supplied to thereby ac turn on the ceramic arc tube 19, when the ceramic arc tube 19 is set horizontal, when the ceramic arc tube 19 is inclined with respect to the horizontal direction H in a front side rising state, and when the ceramic arc tube 19 is inclined with respect to the horizontal direction H in a front side falling state.

[0052] Figs. 5 and 6 respectively show the measured values obtained, in a state where a direct current is sup-

plied to thereby dc turn on the ceramic arc tube 19, when the ceramic arc tube 19 is set horizontal, when the ceramic arc tube 19 is inclined with respect to the horizontal direction H in a front side rising state, and when the ceramic arc tube 19 is inclined with respect to the horizontal direction H in a front side falling state.

[0053] In the tables respectively shown in Figs. 3 and 5, the term "bulb luminous flux" means an emitted luminous flux in the light emitting portion 20 when the light is emitted, while the "lamp luminous flux" means a luminous flux of the light that goes forwardly when the light emitted from the light emitting portion 20 is radiated. Referring to the term "determination", it is used in the following manner. That is, the "maximum radiance" is checked whether it was higher by 3% or more than a value obtained in the horizontal state (the inclination angle of 0°), and the "bulb luminous flux" or "lamp luminous flux" is checked whether it was lower by 3% or more than the value obtained in the horizontal state (the inclination angle of 0°). And, when any one of the "maximum radiance", "bulb luminous flux" and "lamp luminous flux" cannot satisfy the above-mentioned their check conditions, it is determined that a good result could not be obtained.

[0054] In the graphical representations respectively shown in Figs. 4 and 6, the horizontal axis expresses the positions of the light emitting portion 20, while the vertical axis expresses the radiance of the light emitting portion 20. As for the positions of the light emitting portion 20, "0" means the rear end of the light emitting portion 20; and, as the numeric values become larger, the positions are situated more forward.

[0055] As shown in Figs. 4 and 6, when the ceramic arc tube 19 is inclined in its front side rising state, there is generated the maximum radiance on the rear end side of the light emitting portion 20, that is, on the side thereof where it is situated downward. Also, when the ceramic arc tube 19 is inclined in its front side falling state, there is generated the maximum radiance on the front end side of the light emitting portion 20, that is, on the side thereof where it is situated upward.

[0056] In the graphical representations respectively shown in Figs. 4 and 6, in the central portion of the light emitting portion 20, there exists a portion (a depressed portion) where the radiance drops suddenly. The sudden drop of the radiance is caused because the light to be emitted is diffused by the connecting portion 20a.

[0057] In the ac turn-on operation shown in Figs. 3 and 4, when the ceramic arc tube 19 is in its front side rising state, at an inclination angle of 1°, the "maximum radiance" does not provide a rise of 3% or more; and, at the inclination angles of 11° and 15°, the "bulb luminous flux" and "lamp luminous flux" provide a drop of 3% or more. On the other hand, at the inclination angles of 1.5° to 10°, the "maximum radiance", "bulb luminous flux" and "lamp luminous flux" all provide good results.

[0058] Also, in the ac turn-on operation shown in Figs. 3 and 4, when the ceramic arc tube 19 is in its front side falling state, at an inclination angle of 1°, the "maximum

radiance" does not provide a rise of 3% or more; and, at the inclination angles of 11° and 15°, the "bulb luminous flux" and "lamp luminous flux" provide a drop of 3% or more. On the other hand, at the inclination angles of 1.5° to 10°, the "maximum radiance", "bulb luminous flux" and "lamp luminous flux" all provide good results.

[0059] In the dc turn-on operation shown in Figs. 5 and 6, when the ceramic arc tube 19 is in its front side rising state, at an inclination angle of 1°, the "maximum radiance" does not provide a rise of 3% or more; and, at the inclination angles of 11° and 15°, the "lamp luminous flux" provides a drop of 3% or more. On the other hand, at the inclination angles of 1.5° to 10°, the "maximum radiance", "bulb luminous flux" and "lamp luminous flux" all provide good results.

[0060] Also, in the dc turn-on operation shown in Figs. 5 and 6, when the ceramic arc tube 19 is in its front side falling state, at an inclination angle of 1°, the "maximum radiance" does not provide a rise of 3% or more; and, at the inclination angles of 1.5°, 5°, 10°, 11° and 15°, the "bulb luminous flux" and "lamp luminous flux" respectively provide a drop of 3% or more.

[0061] As the inclination angle of the ceramic arc tube 19 with respect to the horizontal direction H decreases, the position where the maximum radiance is generated is easy to overlap with the connecting portion 20a; and, when the inclination angle becomes too large, the lowest temperature (the cold spot temperature) of the ceramic arc tube 19 becomes too low, whereby a drop of the radiance due to the reduced light emitting efficiency is caused.

[0062] Also, in the dc turn-on operation of the discharge lamp 8, when the rear side of the discharge lamp 8 is set for an anode and the front side thereof is set for a cathode, the rear side of the discharge lamp 8 serving as the anode is easy to rise in temperature. Therefore, as can be seen from the measured results shown in Figs. 5 and 6, preferably, the ceramic arc tube 19 may be inclined in a front side rising state in order that the front side of the discharge lamp 8 serving as the cathode is situated upward. By inclining the ceramic arc tube 19 in the front side rising state, a drop in the temperature of the cathode side with respect to the anode side can be restricted, whereby the uneven distribution of the temperature of the ceramic arc tube 19 can be restricted to thereby be able to enhance the light emitting efficiency thereof.

[0063] Therefore, as also can be seen from the measured results shown in Figs. 3 to 6, in the ac turn-on operation, preferably, the ceramic arc tube 19 may be inclined at angles of 1.5° to 10° with respect to the horizontal direction H in its front side rising state or in its front side falling state. And, for the dc turn-on operation, preferably, the ceramic arc tube 19 may be inclined at inclination angles of 1.5° to 10° with respect to the horizontal direction H in the front side rising state.

[0064] In the dc turn-on operation of the discharge lamp 8, when the ceramic arc tube 19 is inclined in the

front side rising state in order that the front side of the discharge lamp 8 serving as the cathode is situated upward, preferably, the connecting portion 20a of the light emitting portion 20 may be formed at a position existing forwardly of the central portion of the light emitting portion 20 in the back-and-forth direction thereof.

[0065] By forming the connecting portion 20a of the light emitting portion 20 at the forward position in this manner, as shown in Fig. 8, it is possible to spread the range of an area A in which high radiance can be provided, thereby being able to facilitate the formation of a lighting pattern necessary for the light that is emitted from the discharge lamp 8.

[0066] Fig. 9 shows measured values respectively obtained when, in the dc turn-on operation of the discharge lamp 8, the ceramic arc tube 19 is set in its horizontal state, is inclined relative to the horizontal direction H in the front side rising state, and is inclined relative to the horizontal direction H in the front side falling state. Here, the measurement in connection with Fig. 9 has been made in such a manner that the inclination angles of the ceramic arc tube 19 are set for 1°, 1.5°, 5°, 10°, 11° and 15°.

[0067] As shown in Fig. 9, in the dc turn-on operation, when the ceramic arc tube 19 was inclined in the front side rising state in order that the front side of the discharge lamp 8 was situated upward, the maximum radiance provided a large rise when compared with a case where the ceramic arc tube 19 is set in the horizontal state. This proves that, in the dc turn-on operation, preferably, the ceramic arc tube 19 may be inclined in the front side rising state in order that the front side of the discharge lamp 8 serving as the cathode is situated upward.

[0068] In the above mode, there has been shown a case where, as an example for inclining the ceramic arc tube 19 with respect to the horizontal direction H, the ceramic arc tube 19 is inclined with respect to the outer tube 18. However, alternatively, as shown in Fig. 10, the discharge lamp 8 may be mounted on the reflector 7 in a state where the whole of the discharge lamp 8 is inclined, and the ceramic arc tube 19 may be inclined with respect to the horizontal direction H. This alternative is not part of the invention as claimed.

[0069] As has been described hereinbefore, in the discharge lamp 8, since the ceramic arc tube 19 is inclined with respect to the horizontal direction H in the front side rising state where the leading end side of the ceramic arc tube 19 is situated upward or in the front falling state where the leading end side of the ceramic arc tube 19 is situated downward, the maximum radiance is not generated at a position corresponding to the connecting portion 20a but is generated at a position existing on the lower side when the ceramic arc tube 19 is inclined.

[0070] Therefore, free from the influence of the diffusion of the light in the connecting portion 20a, there can be secured the maximum radiance of a necessary level and thus sufficient remote visibility can be secured.

[0071] The shapes and structures of the respective parts shown in the above-mentioned best mode for carrying out the invention are only an example of an embodiment to be executed when enforcing the invention. Thus, the technological scope of the invention must not be limited to the above shapes and structures.

[Description of Reference Numerals and Signs]

[0072]

1: Vehicle headlamp
8: Discharge lamp
17: Socket
18: Outer tube
19: Ceramic arc tube
20: Light emitting portion
21a: First Fine tube portion
21b: First Fine tube portion
22: First portion
23: Second portion
24: Front electrode
25: Rear electrode

Claims

1. A vehicle headlamp (1) comprising:

a discharge lamp (8) as a light source, wherein the discharge lamp (8) includes:

an outer tube (18) mounted on a socket (17);
a ceramic arc tube (19) disposed within the outer tube (18) and including a light emitting portion (20), a first fine tube portion (21a) that is continuous with the light emitting portion (20) at a first side of the light emitting portion (20), and a second fine tube portion (21b) that is continuous with the light emitting portion (20) at a second side of the light emitting portion (20) which is opposite to said first side; and
a pair of electrodes (24, 25) respectively disposed within the ceramic arc tube (19),
characterized in that
the ceramic arc tube (19) is inclined with respect to the horizontal direction (H),

wherein the outer tube (18) includes a tubular portion (18a1) having a cylindrical shape, a central axis of which is set on a first axis (Ax1), both of a central axis of the first fine tube portion (21a) and a central axis of the second fine tube portion (21b) are set on a second axis (Ax2), wherein the second axis (Ax2) is inclined with respect to the first axis (Ax1).

2. The vehicle headlamp (1) according to claim 1, wherein the first axis (Ax1) is coincident with the horizontal direction (H), when the vehicle headlamp (1) is mounted in a vehicle.

3. The vehicle headlamp (1) according to any one of claims 1 to 2, wherein a rear end of the outer tube (18) is attached to the socket (17), wherein the ceramic arc tube (19) is inclined in a frond side rising state where a front end of the ceramic arc tube (19) is situated upward.

4. The vehicle headlamp (1) according to any one of claims 1 to 2, wherein a rear end of the outer tube (18) is attached to the socket (17), wherein the ceramic arc tube (19) is inclined in a front side falling state where a front end of the ceramic arc tube (19) is situated upward.

5. The vehicle headlamp (1) according to any one of claims 1 to 4, wherein the ceramic arc tube (19) includes a connecting portion (20a) where a first portion (22) and a second portion (23) are connected together, wherein the first portion (22) is defined by the first fine tube portion (21a) and a portion of the light emitting portion (20), and the second portion (23) is defined by the second fine tube portion (21b) and the other remaining portions of the light emitting portion (20).

6. The vehicle headlamp according to claim 5, wherein the connecting portion (20a) is positioned nearer to the front end of the ceramic arc tube (19) than a center between the pair of electrodes (24, 25).

7. The vehicle headlamp according to claim 1, wherein the ceramic arc tube (19) includes a connecting portion (20a) where a first portion (22) and a second portion (23) are connected together, wherein the first portion (22) includes the first fine tube portion (21a) and a portion of the light emitting portion (20), and the second portion (23) includes the second fine tube portion (21b) and the other remaining portions of the light emitting portion (20), and wherein a position of the connecting portion (20a) in a direction of the second axis (Ax2) is shifted in the direction of the second axis (Ax2) from a center between leading ends (24a, 25a) of the pair of electrodes (24, 25) in the direction of the second axis (Ax2).

Patentansprüche

1. Fahrzeugscheinwerfer (1), umfassend:

eine Entladelampe (8) als Lichtquelle, wobei die Entladelampe (8) beinhaltet:

- eine äußere Röhre (18), die an einem Sockel (17) montiert ist;
 eine keramische Bogenröhre (19), die innerhalb der äußeren Röhre (18) angeordnet ist und einen Lichtaussendeabschnitt (20), einen ersten Feinröhrenabschnitt (21a), der mit dem Lichtaussendeabschnitt (20) auf einer ersten Seite des Lichtaussendeabschnittes (20) kontinuierlich ist, und einen zweiten Feinröhrenabschnitt (21 b), der mit dem Lichtaussendeabschnitt (20) auf einer zu der ersten Seite entgegengesetzten zweiten Seite des Lichtaussendeabschnittes (20) kontinuierlich ist, aufweist; und ein Paar von Elektroden (24, 25), die jeweils innerhalb der keramischen Bogenröhre (19) angeordnet sind,
dadurch gekennzeichnet, dass
 die keramische Bogenröhre (19) in Bezug auf die horizontale Richtung (H) geneigt ist, wobei die äußere Röhre (18) einen röhrenförmigen Abschnitt (18a1) mit einer zylindrischen Form beinhaltet, dessen Mittelachse auf eine erste Achse (Ax1) gelegt ist, wobei beide von einer Mittelachse des ersten Feinröhrenabschnittes (21a) und einer Mittelachse des zweiten Feinröhrenabschnittes (21b) auf eine zweite Achse (Ax2) gelegt sind, wobei die zweite Achse (Ax2) in Bezug auf die erste Achse (Ax1) geneigt ist.
2. Fahrzeugscheinwerfer (1) nach Anspruch 1, wobei die erste Achse (Ax1) mit der horizontalen Richtung (H) zusammenfällt, wenn der Fahrzeugscheinwerfer (1) in einem Fahrzeug montiert ist.
 3. Fahrzeugscheinwerfer (1) nach einem von Ansprüchen 1 bis 2, wobei ein rückwärtiges Ende der äußeren Röhre (18) an dem Sockel (17) angebracht ist, wobei die keramische Bogenröhre (19) in einem vorderseitigen steigenden Zustand geneigt ist, in dem ein vorderes Ende der keramischen Bogenröhre (19) nach oben gerichtet ist.
 4. Fahrzeugscheinwerfer (1) nach einem von Ansprüchen 1 bis 2, wobei ein rückwärtiges Ende der äußeren Röhre (18) an dem Sockel (17) angebracht ist, wobei die keramische Bogenröhre (19) in einem vorderseitigen fallenden Zustand geneigt ist, in dem ein vorderes Ende der keramischen Bogenröhre (19) nach oben gerichtet ist.
 5. Fahrzeugscheinwerfer (1) nach einem von Ansprüchen 1 bis 4, wobei die keramische Bogenröhre (19) einen Verbindungsabschnitt (20a) beinhaltet, wo ein erster Abschnitt (22) und ein zweiter Abschnitt (23) miteinander verbunden sind, wobei der erste Ab-

schnitt (22) durch den ersten Feinröhrenabschnitt (21a) und einen Abschnitt des Lichtaussendeabschnittes (20) festgelegt ist und der zweite Abschnitt (23) durch den zweiten Feinröhrenabschnitt (21b) und die weiteren verbleibenden Abschnitte des Lichtaussendeabschnittes (20) festgelegt ist.

6. Fahrzeugscheinwerfer nach Anspruch 5, wobei der Verbindungsabschnitt (20a) näher an dem vorderen Ende der keramischen Bogenröhre (20) als eine Mitte zwischen dem Paar von Elektroden (24, 25) positioniert ist.
7. Fahrzeugscheinwerfer nach Anspruch 1, wobei die keramische Bogenröhre (19) einen Verbindungsabschnitt (20a) beinhaltet, wo ein erster Abschnitt (22) und ein zweiter Abschnitt (23) miteinander verbunden sind, wobei der erste Abschnitt (22) den ersten Feinröhrenabschnitt (21a) und einen Abschnitt des Lichtaussendeabschnittes (20) beinhaltet und der zweite Abschnitt (23) den zweiten Feinröhrenabschnitt (21b) und die weiteren verbleibenden Abschnitte des Lichtaussendeabschnittes (20) beinhaltet und wobei eine Position des Verbindungsabschnittes (20a) in einer Richtung der zweiten Achse (Ax2) in der Richtung der zweiten Achse (Ax2) von einer Mitte zwischen führenden Enden (24a, 25a) des Paares von Elektroden (24, 25) in der Richtung der zweiten Achse (Ax2) verschoben ist.

Revendications

1. Phare de véhicule (1) comprenant :

une lampe à décharge (8) à titre de source de lumière, ladite lampe à décharge (8) incluant :

un tube extérieur (18) monté sur un socle (17) ;

un tube à arc en céramique (19) disposé dans le tube extérieur (18) et

incluant une portion d'émission de lumière (20), une première portion de tube fin (21a) qui est en continu avec la portion d'émission de lumière (20) sur un premier côté de la portion d'émission de lumière (20), et une seconde portion de tube (21b) qui est en continu avec la portion d'émission de lumière (20) sur un second côté de la portion d'émission de lumière (20) qui est opposé audit premier côté ; et

une paire d'électrodes (24, 25) disposées respectivement dans le tube à arc en céramique (19),

caractérisé en ce que

le tube à arc en céramique (19) est incliné par rapport à la direction horizontale (H),

dans lequel le tube extérieur (18) inclut une portion tubulaire (18a1) ayant une forme cylindrique, dont un axe central est placé sur un premier axe (Ax1),
un axe central de la première portion de tube fin (21a) et un axe central de la seconde portion de tube fin (21b) sont placés sur un second axe (Ax2),
dans lequel le second axe (Ax2) est incliné par rapport au premier axe (Ax1).

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2. Phare de véhicule (1) selon la revendication 1, dans lequel le premier axe (Ax1) coïncide avec la direction horizontale (H) quand le phare de véhicule (1) est monté dans un véhicule.

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3. Phare de véhicule (1) selon l'une quelconque des revendications 1 à 2, dans lequel une extrémité arrière du tube extérieur (18) est attachée sur le socle (17), dans lequel le tube à arc en céramique (19) est incliné dans une situation en montant du côté avant, dans laquelle une extrémité avant du tube à arc en céramique (19) est située vers le haut.

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4. Phare de véhicule (1) selon l'une quelconque des revendications 1 à 2, dans lequel une extrémité arrière du tube extérieur (18) est attachée sur le socle (17),
dans lequel le tube à arc en céramique (19) est incliné dans une situation en descendant du côté avant, dans laquelle une extrémité avant du tube à arc en céramique (19) est située vers le haut.

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5. Phare de véhicule (1) selon l'une quelconque des revendications 1 à 4, dans lequel le tube à arc en céramique (19) inclut une portion de connexion (20a) dans laquelle une première portion (22) et une seconde portion (23) sont connectées ensemble, dans lesquelles la première portion (22) est définie par la première portion de tube fin (21a) et par une partie de la portion d'émission de lumière (20), et la seconde portion (23) est définie par la seconde portion de tube fin (21b) et par les autres parties restantes de la portion d'émission de lumière (20).

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6. Phare de véhicule (1) selon la revendication 5, dans lequel la portion de connexion (20a) est positionnée plus proche de l'extrémité avant du tube à arc en céramique (19) qu'un centre entre la paire d'électrodes (24, 25).

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7. Phare de véhicule (1) selon la revendication 1, dans lequel le tube à arc en céramique (19) inclut une portion de connexion (20a) dans laquelle une première portion (22) et une seconde portion (23) sont connectées ensemble, dans lesquelles la première portion (22) inclut la première portion de tube fin (21a) et une partie de la portion d'émission de lumière

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re (20), et la seconde portion (23) inclut la seconde portion de tube fin (21b) et les autres parties restantes de la portion d'émission de lumière (20), et dans lequel une position de la portion de connexion (20a) dans une direction du second axe (Ax2) est située dans la direction du second axe (Ax2) depuis un centre entre des extrémités avant (24a, 25a) de la paire d'électrodes (24, 25) dans la direction du second axe (Ax2).

FIG. 1

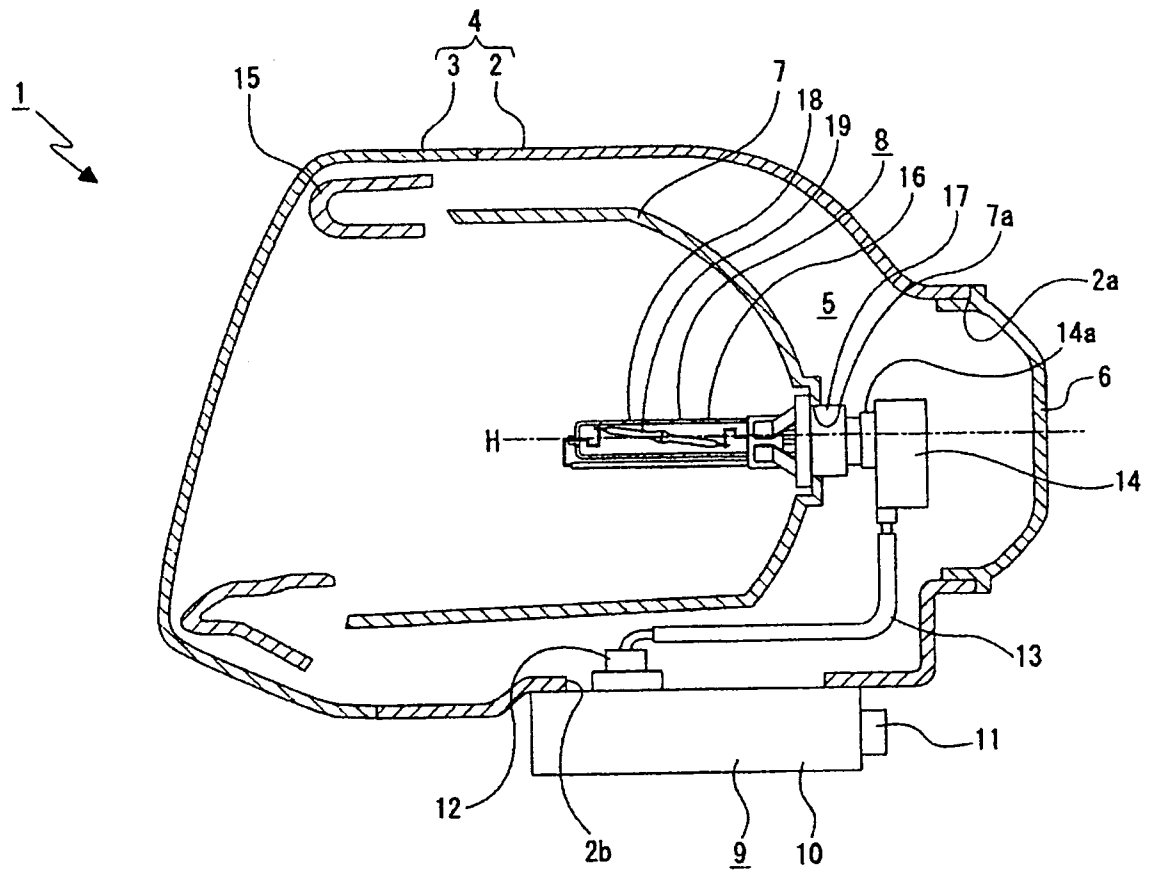


FIG. 2

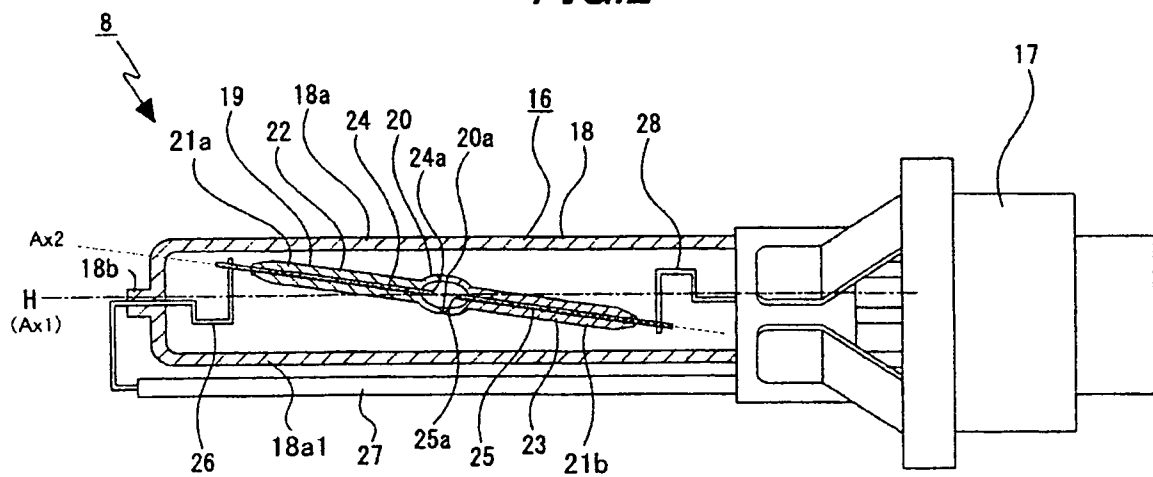


FIG.3

AC TURN-ON OPERATION		MAXIMUM RADIANCE	BULB LUMINOUS FLUX	LAMP LUMINOUS FLUX	DETERMINATION
FRONT SIDE RISING STATE	15°	9010	2377 x	1010 x	x
	11°	9270	2487 x	1165 x	x
	10°	9351	2590	1298	○
	5°	8944	2600	1311	○
	1.5°	8431	2600	1320	○
	1°	8070 x	2600	1324	x
HORIZONTAL STATE	0°	8056	2600	1324	—
FRONT SIDE FALLING STATE	1°	8070 x	2600	1324	x
	1.5°	8659	2602	1322	○
	5°	8912	2600	1325	○
	10°	8990	2631	1311	○
	11°	8980	2517 x	1125 x	x
	15°	8909	2464 x	1040 x	x

UNIT (lumen)

○: GOOD

x: NO GOOD

FIG.4

AC TURN-ON OPERATION

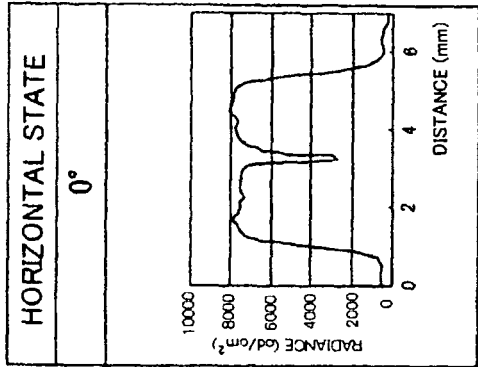
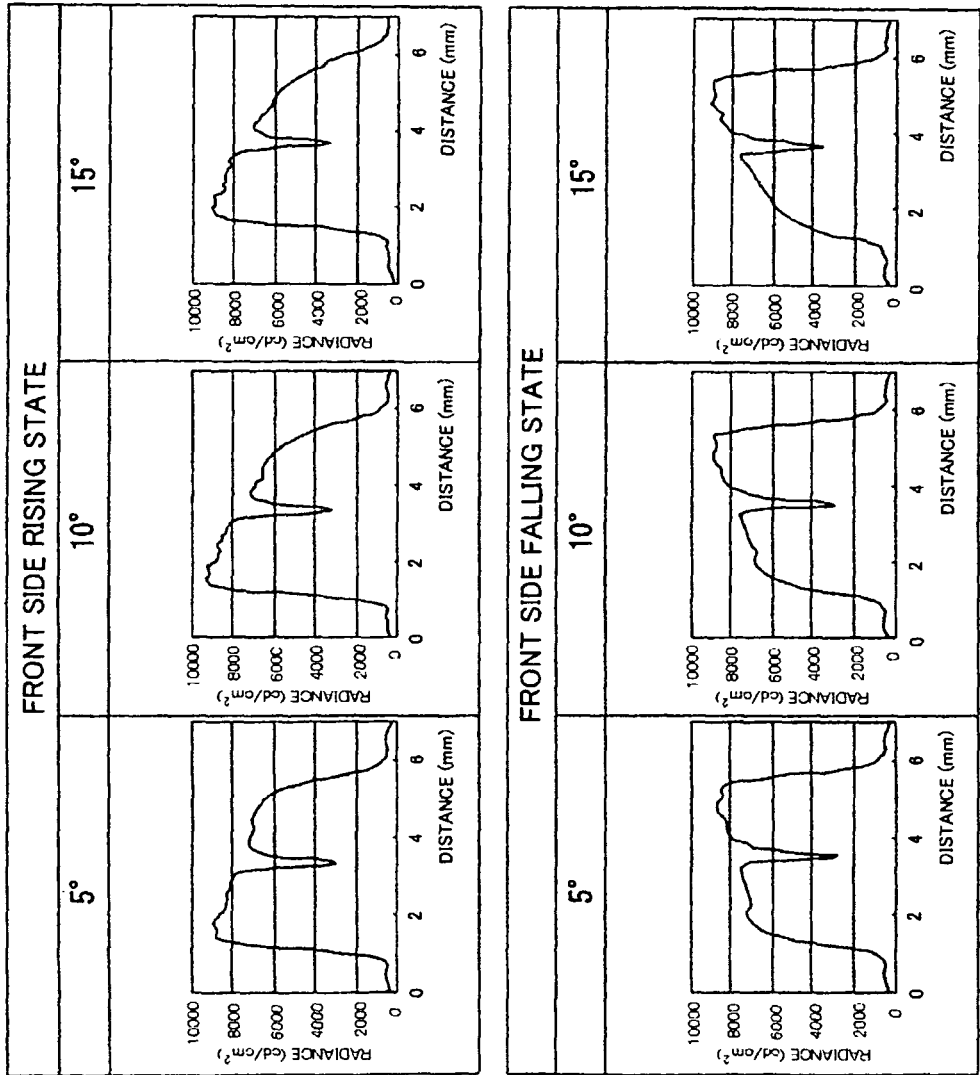


FIG.5

AC TURN-ON OPERATION		MAXIMUM RADIANCE	BULB LUMINOUS FLUX	LAMP LUMINOUS FLUX	DETERMINATION
FRONT SIDE RISING STATE	15°	7932	2722	1192 x	x
	11°	8250	2699	1251 x	x
	10°	8317	2692	1364	○
	5°	8601	2733	1390	○
	1.5°	7810	2673	1357	○
	1°	7120 x	2600	1324	x
HORIZONTAL STATE	0°	7077	2600	1324	—
FRONT SIDE FALLING STATE	1°	7110 x	2600	1324	x
	1.5°	7920	2539 x	1275 x	x
	5°	8447	2529 x	1251 x	x
	10°	8732	2518 x	1192 x	x
	11°	8710	2502 x	1165 x	x
	15°	8555	2467 x	861 x	x

UNIT (lumen)

○: GOOD

x: NO GOOD

FIG.6

DC TURN-ON OPERATION

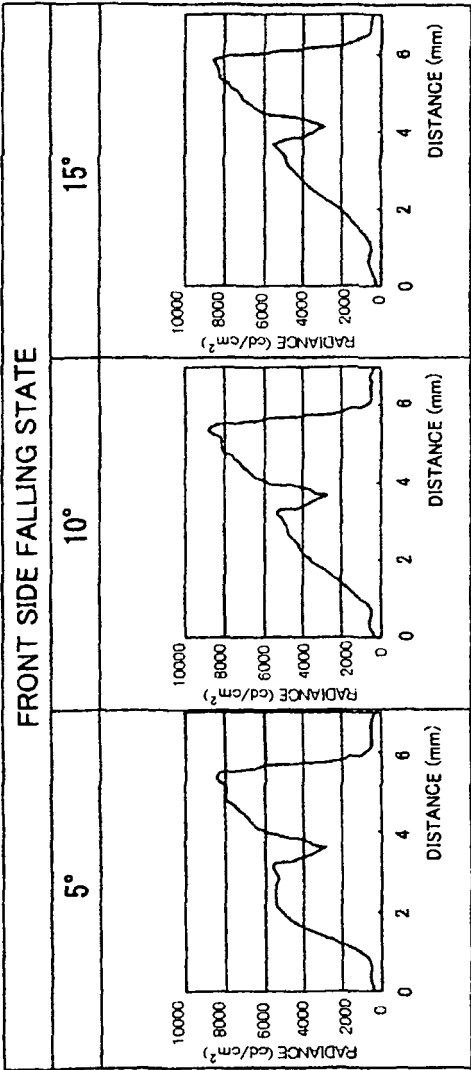
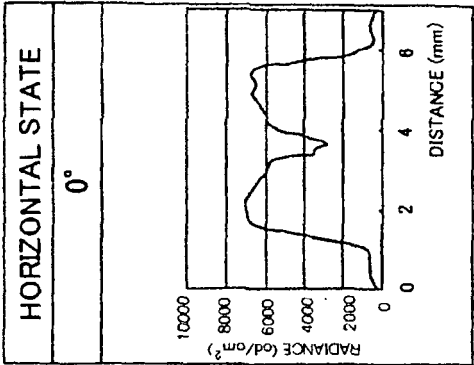
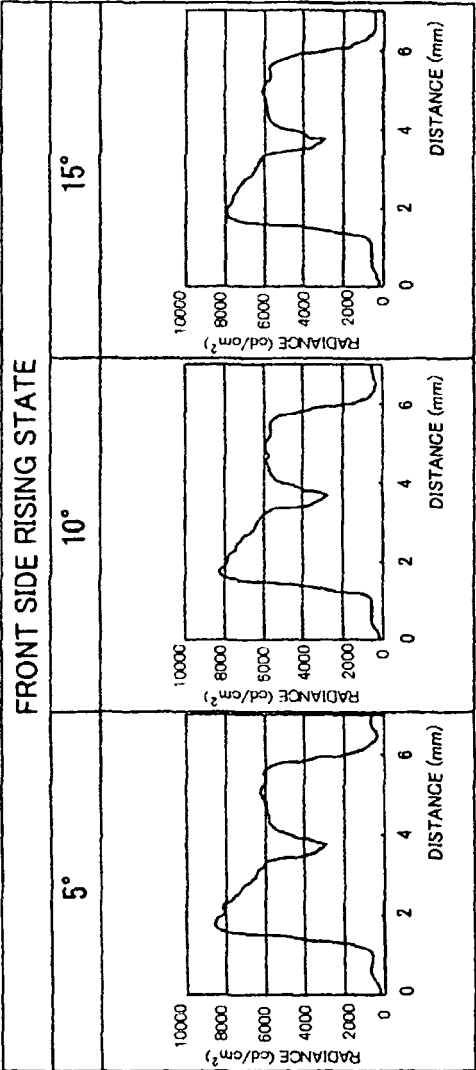


FIG. 7

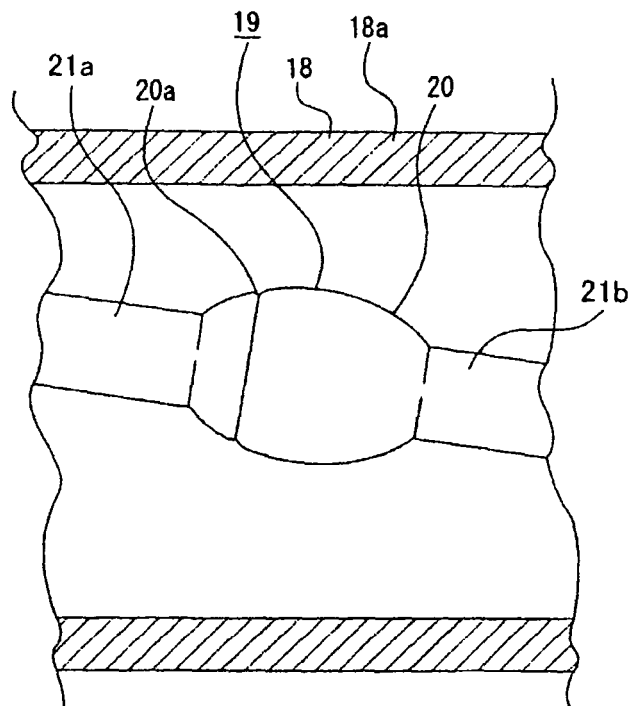


FIG. 8

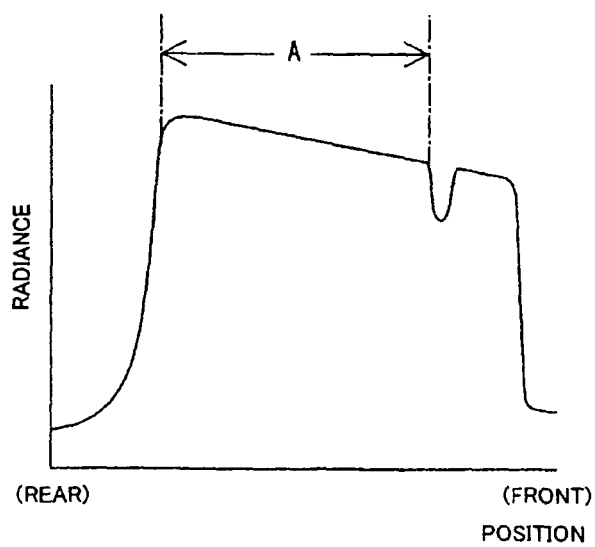


FIG.9

DC TURN-ON OPERATION (CONNECTING POSITION IS CHANGED)

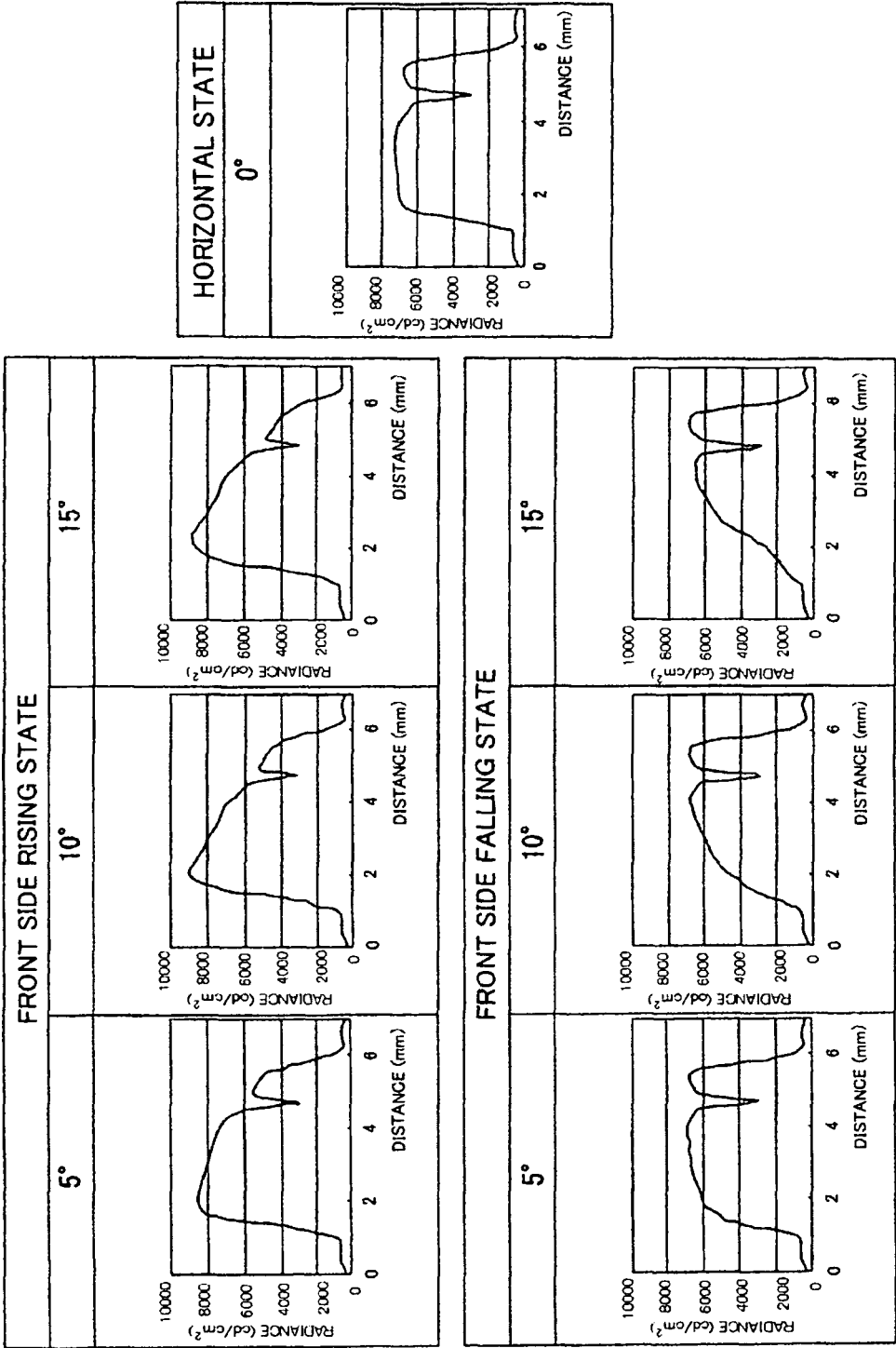
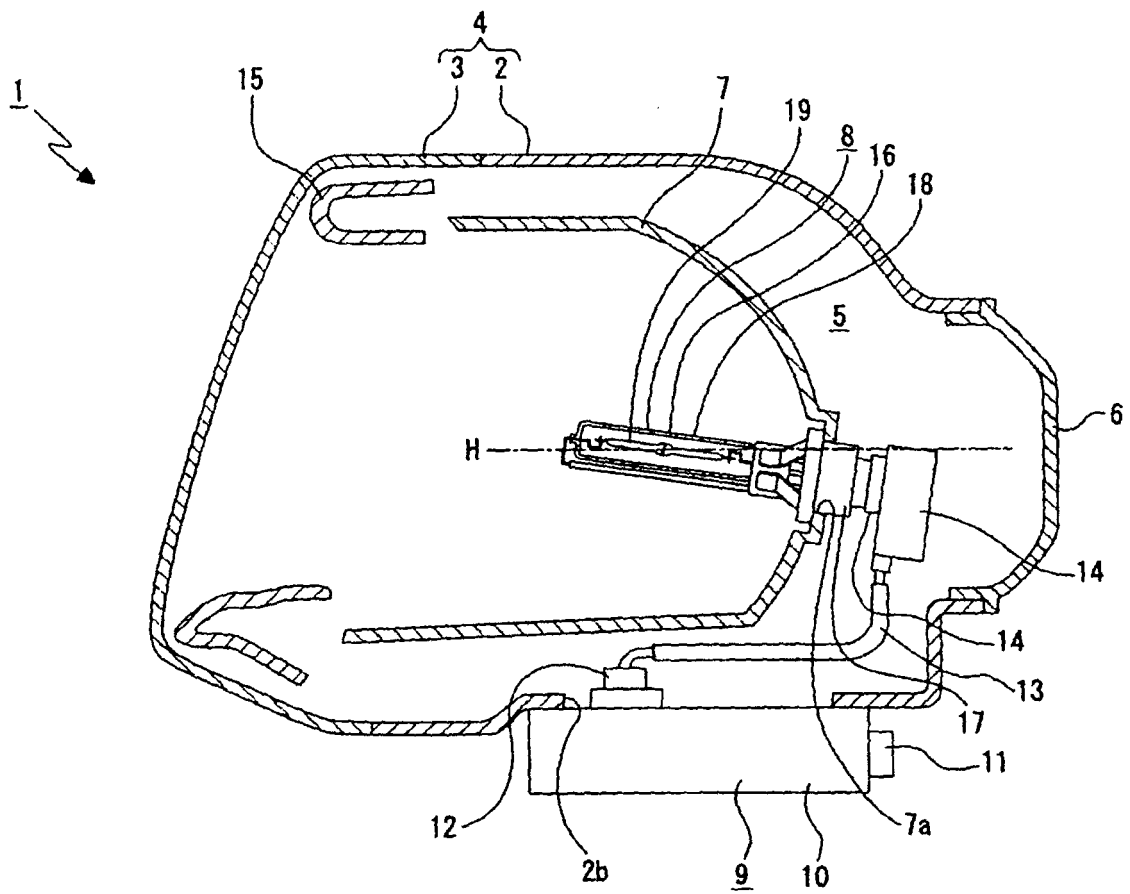


FIG. 10



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2000447 A2 [0008]
- EP 2000947 A2 [0011]
- JP 2007188758 A [0012]
- JP 7114807 A [0012]
- US 20060171162 A1 [0012]