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(71) Applicant: **Harison Toshiba Lighting Corporation**
Imabari-shi,
Ehime 794-8510 (JP)

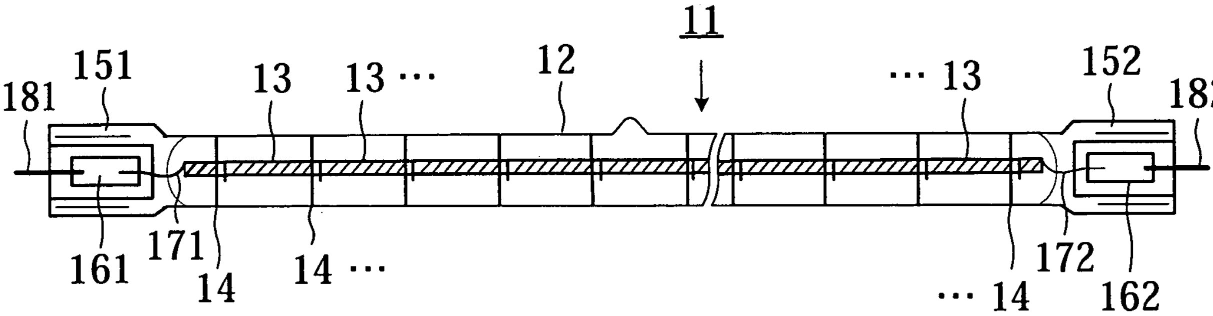
(72) Inventors:
- **Gogami, Yasutaka,**
  Harrison Toshiba Lighting Corp
  Imabari-shi
  Ehime 794-8510 (JP)
- **Sakamoto, Seiji,**
  Harrison Toshiba Lighting Corp
  Imabari-shi
  Ehime 794-8510 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) **Lamp type heater and manufacturing method thereof**

(57) A luminescent color is controlled easily without changing a manufacturing condition and a film material, by forming films on a radiation transmissive bulb on whose surface a Frost process is performed while varying a film thickness into concave and convex to thereby adjust the film thickness. A depth of a Frost 19 formed by performing a Frost process on a surface of a bulb 12 made of quartz glass, is set to be approximately over 4 μm, or 2μm or more and 4μm or less. As a first layer, a low refractive index film 21 whose major constituent is SiO_2 is formed by coating it on the Frost 19 by a dipping method and thereafter baking it, and as a second layer, a high refractive index film 22 whose major constituent is Fe_2O_3 is formed by coating it by the dipping method and thereafter baking it. The low refractive index films 21 and the high refractive index films 22 of a third and subsequent layers are alternately formed in plural layers.

FIG. 1



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Description

CROSS-REFERENCE TO THE INVENTION

[0001] This application is based upon and claims the benefit of priority from the prior Japanese Patent Application No. 2004-287011, filed on September 30, 2004; the entire contents of which are incorporated herein by reference.

BACKGROUND

1. FIELD OF THE INVENTION

[0002] The present invention relates to a lamp type heater and a manufacturing method thereof, using a halogen lamp including an optical filter film on an outer surface of a radiation transmissive bulb.

2. DESCRIPTION OF THE RELATED ART

[0003] Conventionally, a halogen lamp heater in which a plurality of high refractive index films and low refractive index films are formed on an outer surface of a bulb of a lamp in which a tungsten filament is accommodated inside a radiation transmissive bulb, is used as an infrared ray light source having a glare-proof effect in which a wavelength region of a visible light is cut and the wavelength region of the infrared ray is selectively transmitted (for example, refer to Japanese Patent Application Laid-open No. Hei 3-226959, Page 2 and FIG. 2).

[0004] In an art disclosed in the above-stated Japanese Patent Laid-openApplicationNo. Hei 3-226959, normally, luminescent colors become approximately equal when film formations are performed on the halogen lamp heaters of the same specifications under a constant manufacturing condition and film material. However, it was difficult for this kind of heaters to meet a request to change the luminescent color according to various uses.

SUMMARY OF THE INVENTION

[0005] An object of the present invention is to provide a lamp type heater and a manufacturing method thereof capable of controlling a luminescent color easily without changing a manufacturing condition and a film material by forming films while varying a film thickness into concave and convex, to thereby adjust the film thickness.

[0006] To solve the above-statedproblem, a lamp type heater according to an aspect of the present invention includes: a bulb having a radiation transmissive property in which low refractive index films and high refractive index films are alternately formed in plural layers on an outer surface; and an electrical resistance wire sealed inside the bulb, and wherein a concave and convex with a predetermined depth is formed on the outer surface of the bulb, and the low refractive index films and the high refractive index films are formed on the concave and convex surface. Here, the concave and convex formed on the outer surface of the bulb may be made by a Frost process with a predetermined depth. Besides, the low refractive index film may be the low refractive index film including SiO_2, the high refractive index film may be the high refractive index film including metal oxide, and the electrical resistance wiremay be essentially consisted of a fire-resistant metal . The depth of the concave and convex formed on the outer surface of the bulb may be over 4 μm, or it may be 2 μm or more and 4 μm or less. The low refractive index films and the high refractive index films alternately formed in plural layers may be formed so as to satisfy a relation of $0.05 < Dmin/Dmax < 1$ when a maximum value of a film thickness as a whole is set as Dmax, and a minimum value thereof is set as Dmin.

[0007] Besides, a manufacturing method of a lamp type heater which includes a bulb having a radiation transmissive property and an electrical resistance wire sealed inside the bulb, according to another aspect of the present invention, includes: performing a Frost process with a predetermined depth on a surface of the radiation transmissive bulb; forming a low refractive index film of a first layer by coating and thereafter baking a low refractive index film solution whose major constituent is SiO_2 on the surface of the radiation transmissive bulb; forming a high refractive index film of a second layer by coating and thereafter baking a high refractive index film solution whose major constituent is Fe_2O_3 on the first layer; and repeatedly forming the low refractive index films and the high refractive index films of a third and subsequent layers alternately in plural layers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1 is a config.urationview for explaining a first embodiment of the present invention.
FIG. 2 is a partial enlarged view showing a substantial part of FIG. 1 with enlargement.
FIG. 3 is a partial enlarged view showing a part shown by III in FIG. 2 with further enlargement.
FIG. 4 is an explanatory view for explaining a change of a luminescent color according to a third embodiment of the present invention.
FIG. 5 is an explanatory view for explaining a chromaticity distribution according to the third embodiment of the present invention.
FIG. 6 is a partial enlarged view showing a substantial part of a fourth embodiment of the present invention.
FIG. 7 is a partial enlarged view showing a part shown by VII in FIG. 6 with further enlargement.

DETAILED DESCRIPTION

[0009] Hereinafter, embodiments of the present invention are described in detail with reference to the drawings.

[0010] FIG. 1 and FIG. 2 are views for explaining a first embodiment of the present invention, and FIG. 1 is a configuration view showing an entire configuration of a halogen lamp, FIG. 2 is an enlarged view of a substantial part of FIG. 1, and FIG. 3 is an enlarged view of a substantial part of FIG. 2 with further enlargement.

[0011] In FIG. 1 and FIG. 2, a reference numeral 11 denotes a halogen lamp, and it is a tubular halogen lamp which is in heavy use as, for example, a heater for keeping heats in foods and so on. The halogen lamp 11 has a bulb 12 made of quartz glass and so on, having a radiation transmissive property. The bulb 12 accommodates a tungsten filament 13 being an example of a heat source in a concentric state inside thereof. A concentric structure of this filament 13 relative to the bulb 12 is held by anchors 14 plurally arranged in an axial direction within the bulb 12. Besides, a predetermined amount of a halogen gas is sealed in the bulb 12 together with an inert gas such as argon. A pair of sealing end portions 151 and 152 in rectangular flattened shapes are formed at both end portions in the axial direction of the bulb 12 by pinch seals crushing in diametrical direction of the bulb 12. Molybdenum foils 161 and 162 in rectangular foil states are respectively embedded in the sealing end portions 151 and 152.

[0012] Both ends of the filament 13 in the axial direction are connected to respective inner end portions of the molybdenum foils 161 and 162 via a pair of inner lead lines 171 and 172, and similarly, a pair of outer lead lines 181 and 182 are respectively connected to respective outer end portions thereof. The respective outer lead lines 181 and 182 are extending outside from the respective sealing end portions 151 and 152 while keeping an air-tightness.

[0013] On an outer surface of the bulb 12, a Frost with a depth of approximately over 4 μm is formed by a Frost process for forming a fine concave and convex by using, for example, a sandblaster (fine-grained sand).

[0014] As shown in FIG. 3 in which a surrounded portion shown by III in FIG. 2 is further enlarged, a low refractive index film 21 whose major constituent is SiO_2 is formed on a Frost 19, and a high refractive index film 22 whose major constituent is, for example, Fe_2O_3 being metal oxide is formed on this low refractive index film 21. After that, the low refractive index films 21 and the high refractive index films 22 are formed alternately in plural layers.

[0015] In this embodiment, it is possible to prevent a glare owing to an optical interference film effect by forming the Frost 19 with the depth of over 4 μm on the surface of the bulb 12, and forming the low refractive index films 21 and the high refractive index films 22 alternately in plural layers on the Frost 19. In this case, it is possible to obtain a luminescent color of yellow (approximate to a candle color) with a good color rendering property having a range of 0.570 $\pm$ 0.015 in an x coordinate, and 0.400 $\pm$ 0.01 in a y coordinate of a chromaticity distribution.

[0016] Next, a second embodiment of the present invention is described. In this embodiment, a Frost 19 with a depth of 2 μm to 4 μm is formed on an outer surface of a bulb 12 by a Frost process using, for example, a sandblaster. On this Frost, low refractive index films 21 and high refractive index films 22 are alternately formed in plural layers, as same as the above-stated embodiment.

[0017] In this embodiment, the Frost 19 with the depth of 2 μm to 4 μm is formed on a surface of the bulb 12, the low refractive index films 21 and the high refractive index films 22 are formed alternately in plural layers on the Frost 19, and thereby, a glare can be prevented owing to an optical interference film effect. In this case, it is possible to obtain a luminescent color of orange to yellow with a good color rendering property having a range of 0.595 $\pm$ 0.015 in an x coordinate, and 0.385 $\pm$ 0.01 in a y coordinate of a chromaticity distribution.

[0018] Here, an embodiment of a manufacturing method of a lamp type heater according to the present invention is described with reference to FIG. 3, in which low refractive index films and high refractive index films are formed alternately in plural layers on a Frost 19 formed on a bulb 12.

[0019] First, a process forming the Frost 19 with the depth of approximately over 4 μm (or approximately 2 μm to 4 μm) is performed on the surface of the bulb 12 by using the sandblaster.

[0020] As a first layer, a low refractive index film solution whose major constituent is SiO_2 is coated on the surface of the Frost 19 by a dipping method, and thereafter it is baked to form a low refractive index film 21.

[0021] Next, as a second layer, a high refractive index film solution whose major constituent is Fe_2O_3 is coated on the low refractive index film 21, and thereafter it is baked to form a high refractive index film 22.

[0022] Similarly, the low refractive index films 21 and the high refractive index films 22 of a third and subsequent layers are alternately coated and baked repeatedly to be formed in plural layers.

[0023] By going through the above-stated processes, the low refractive index films 21 and the high refractive index films 22 can be alternately formed in plural layers on the Frost 19 with the depth of approximately over 4 μm (or approximately 2 μm to 4 μm) .

[0024] A third embodiment of the present invention is described with reference to FIG. 3 again. In this embodiment, a minimum film thickness of low refractive index films 21 and high refractive index films 22 alternately formed in plural layers on a Frost 19 is set as Dmin, a maximum film thickness thereof is set as Dmax, and Dmin/Dmax is adjusted to a desired value. When Dmin/Dmax becomes 0.05 or less, the film thickness of the low refractive index films 21 and the high refractive index films 22 positioned at Dmax becomes large, and a gap of which cause is considered to be a difference of respective expansion ratios is formed within the film of the low refractive index film 21. This may be an occurrence cause of a film peeling.

[0025] Consequently, the film thickness is set to be within a range of 0.05 < Dmin/Dmax < 1. It is possible to realize a controlling of a luminescent color with a very good color rendering property by adjusting Dmin/Dmax within this range. Hereinafter, this is explained with reference to FIG. 4 and FIG. 5.

[0026] FIG. 4 shows an example in which the Frost 19 is formed on an outer surface of a bulb 12, the low refractive index films 21 and the high refractive index films 22 are alternately formed in plural layers, and the films are formed while varying the film thickness in a concave and convex state as shown in FIG. 3. At this time, three kinds of lamps A, B, and C having different Dmin/Dmax produced with varying the depth of the Frost 19, and a lamp produced by alternately forming the low refractive index films 21 and the high refractive index films 22 in plural layers without a Frost, are compared.

[0027] By this comparison, the luminescent color without the Frost is red, on the contrary, the luminescent colors with Frost become controllable to a voluntary color from yellow to orange in accordance with the change of Dmin/Dmax.

[0028] As it is obvious from FIG. 5 showing a chromaticity distribution of the three kinds of lamps of A, B, and C with the above-stated different Frost depths, and the lamp without the Frost, it turns out that the lamp without the Frost shows the luminescent color of red at 0.643 in an x coordinate and 0.351 in a y coordinate of the chromaticity distribution, and the lamps A to C are from a yellow region to an orange region in xy coordinates of the chromaticity distribution.

[0029] As it can be seen from this result, Dmin/Dmax is adjusted by varying the film thickness, and thereby, it becomes possible to control the luminescent color from the yellow region to the orange region.

[0030] According to the embodiments of the present invention, it is possible to eliminate or reduce a peeling of a coating film or a leakage of a light in a vicinity of a chip portion when low refractive index films and high refractive index films are coated in plural layers on an outer surface. Besides, according to the embodiments of the present invention, a lighting color when lighted is from yellow to orange, and thereby, it is possible to provide a lamp type heater with a very good color rendering property.

[0031] Next, a fourth embodiment of the present invention is described in detail. According to a lamp type heater of the present embodiment, means for preventing a salt damage is further added to the lamp type heater of the first to the third embodiments.

[0032] The several installation locations of the lamp type heater are considered because the lamp type heater is generally used as a space heater in many cases. It is not negligible that the lamp type heater is exposed to the sodium chloride included in the sea breeze and/or the seawater when the lamp type heater is installed at the place such as the waterfront where it is exposed to the sea breeze.

[0033] The sodium chloride (NaCl) is dispersed in the amorphous structure of, e. g. silica glass, due to the dissociation of the sodium ion. Then the sodium ion becomes a core and the silica glass is known to be crystallized. (see Japanese Patent Publication H3-74361)

[0034] It is desirable to reduce or prevent the crystallization phenomena of the lamp type heater coated with plural layers of the low refractive index films and the high refractive index films of the above first to third embodiments even if the lamp type heater is installed at the place exposed to the sea breeze or seawater.

[0035] The crystallization phenomena of the silica glass caused by the sodium chloride are generally well-known and the lamp type heater using the silica glass is not suitable for installing at the waterfront or the place taken the seawater in existence of the sodium chloride. In case of installation, it is necessary for the lamp apparatus having the lamp type heater to apply some contrivances preventing the sodium chloride from direct contact to the lamp type heater (for example sealed type apparatus).

[0036] According to the lamp type heater of the present embodiment, at least one metal oxide solution selected from the group consisting of TiO_2 (Titania), Al_2O_3 (Alumina), ZrO_2 (Zirconia), CeO_2 (Ceria), MgO (Magnesia), Y_2O_3 (Yttria), ZnO (Zinc oxide), HfO_2 (Hafnia), TiO (Titanium monoxide), Ta_2O_5 (Tantalumpent oxide) and so on, is further coated on the surface of the lamp type heater of the first to the third embodiments as single layer or plural layers and baked. This enables to delay or prevent the occurrence of crystallization of the heater emitting portion without using sealed type apparatus when exposed to the sodium chloride included in sea breeze and/or seawater.

[0037] Hereafter, the lamp type heater of the present embodiment will be described in detail with reference to the FIG. 6 and FIG.7. FIG.6 is a partial enlarged view showing a substantial part of the present embodiment and FIG.7 is a partial enlarged view showing a part shown by VII in FIG. 6 with further enlargement. The same reference signs shown in FIG.2 and FIG.3 are put to the corresponding same component parts and the duplicate explanation will be omitted.

[0038] First, a process forming the Frost 19 with the depth of approximately over 4 μm (or approximately 2 μm to 4 μm) is performed on the surface of the bulb 12 of the lamp type heater 31 shown in FIG. 6 and FIG. 7. As a first layer, a low refractive index film solution whose major constituent is SiO_2 is coated on the surface of the Frost 19 by a dipping method, and thereafter it is baked to form a low refractive index film 21. Next, as a second layer, a high refractive index film solution whose major constituent is Fe_2O_3 is coated on the low refractive index film 21, and thereafter it is baked to form a high refractive index film 22. Similarly, the low refractive index films 21 and the high refractive index films 22 of a third and subsequent layers are alternately coated and baked repeatedly to be formed in plural layers.

[0039] Moreover, as an overcoat, the metal oxide solution, such as at least one selected from the group consisting of TiO_2 (Titania), Al_2O_3 (Alumina), ZrO_2 (Zirconia), CeO_2 (Ceria), MgO (Magnesia), Y_2O_3 (Yttria), ZnO (Zinc oxide), HfO_2 (Hafnia) , TiO (Titanium monoxide) , Ta_2O_5 (Tantalum pent oxide) and so on, is coated in one or plural layers to form the metal oxide film layer 32 on the surface of the low refractive index films 21 and the high refractive index films 22 formed alternately.

[0040] According to the lamp type heater obtained by the above steps, it enables to delay or prevent the occurrence of crystallization of the heater emitting portion even if the lamp type heater is exposed to the sodium chloride included in sea breeze or seawater and so on. When TiO_2 (Titania) is used as metal oxide solution, it further enables to have a capability of deodorizing effect and stainproof effect as photocatalyst, and enables to prevent occurrence of trouble so as to extend the lighting lifetime.

Claims

1. A lamp type heater, comprising:

a bulb having a radiation transmissive property in which low refractive index films and high refractive index films are alternately formed in plural layers on an outer surface; and
an electrical resistance wire sealed inside said bulb,
characterized in that
a concave and convex with a predetermined depth is formed on the outer surface of said bulb, and the low refractive index films and the high refractive index films are formed on the concave and convex surface.

2. A lamp type heater according to claim 1, wherein the concave and convex formed on the outer surface of said bulb is made by a Frost process with a predetermined depth.

3. A lamp type heater according to any one of claim 1 and claim 2, wherein the low refractive index film is the low refractive index film including SiO_2, the high refractive index film is the high refractive index film including metal oxide, and the electrical resistance wire is essentially consisted of fire-resistant metal.

4. A lamp type heater according to any one of claims 1 to 3, wherein the depth of the concave and convex formed on the outer surface of said bulb is over 4 μm.

5. A lamp type heater according to any one of claims 1 to 3, wherein the depth of the concave and convex formed on the outer surface of said bulb is 2 μm or more and 4 μm or less.

6. A lamp type heater according to any one of claims 1 to 5, wherein the low refractive index films and the high refractive index films alternately formed in plural layers are formed so as to satisfy a relation of 0.05 < Dmin/Dmax < 1 when a maximum value of a film thickness as a whole is set as Dmax, and a minimum value thereof is set as Dmin.

7. Amanufacturingmethodof a lamp type heater which includes a bulb having a radiation transmissive property and an electrical resistance wire sealed inside the bulb, comprising:

performing a Frost process with a predetermined depth on a surface of the radiation transmissive bulb;
forming a low refractive index film of a first layer by coating and thereafter baking a low refractive index film solution whose major constituent is SiO_2 on the surface of the radiation transmissive bulb;
forming a high refractive index film of a second layer by coating and thereafter baking a high refractive index film solution whose major constituent is Fe_2O_3 on the first layer; and
repeatedly forming the low refractive index films and the high refractive index films of a third and subsequent layers alternately in plural layers.

8. A lamp type heater according to any one of claims 1 to 6, wherein a metal oxide film is further formed on top layer of the low refractive index films and the high refractive index films alternately formed in plural layers.

9. A lamp type heater according to claim 8, wherein the metal oxide film includes at least one of metal oxide selected from the group consisting of TiO_2 (Titania), Al_2O_3 (Alumina), ZrO_2 (Zirconia), CeO_2 (Ceria), MgO (Magnesia), Y_2O_3 (Yttria), ZnO (Zinc oxide) , Hf02 (Hafnia), TiO (Titanium monoxide), Ta_2O_5 (Tantalum pentoxide).

10. A lamp type heater according to claim 9, wherein the metal oxide film includes at least TiO_2 (Titania) .

FIG. 1

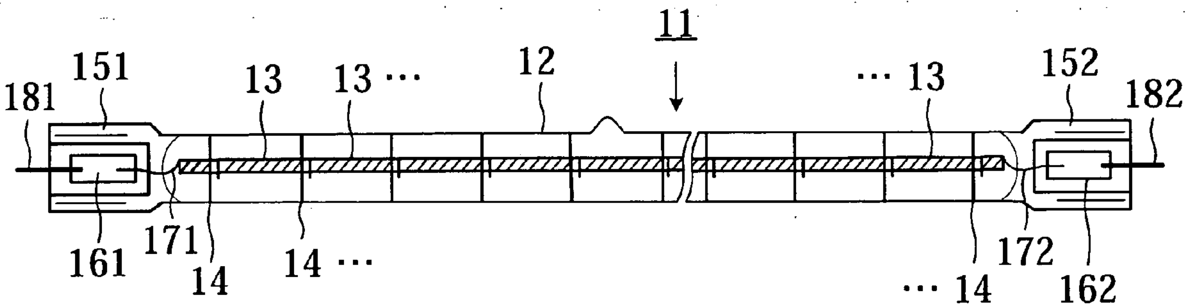
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FIG. 2

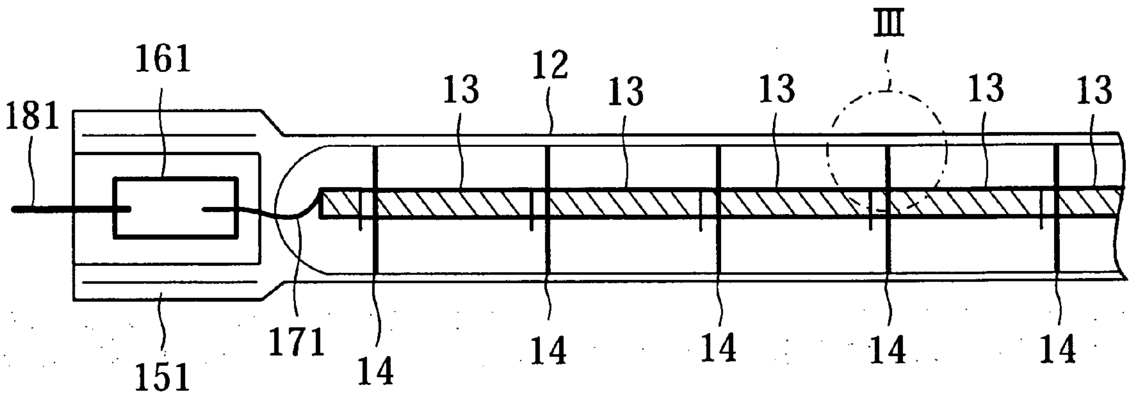
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FIG. 3

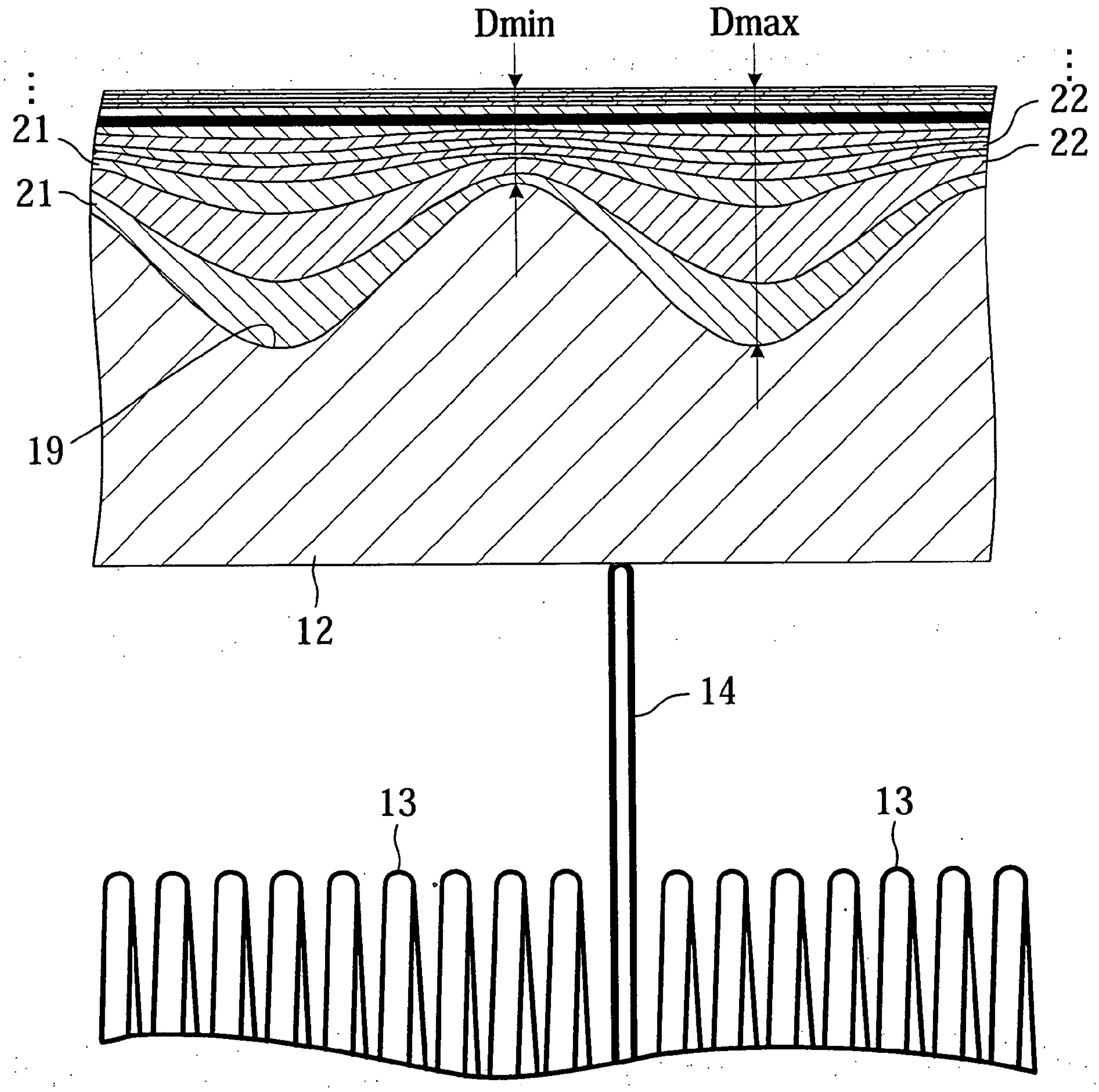

FIG. 4

LAMP	Dmin/Dmax	CHROMATICITY		LUMINESCNET COLOR
		x	y	
A	0.11	0.583	0.394	YELLOW ⇕ ORANGE RED
B	0.40	0.602	0.383	
C	0.61	0.614	0.375	
WITHOUT FROST	0.97	0.643	0.351	

FIG. 5

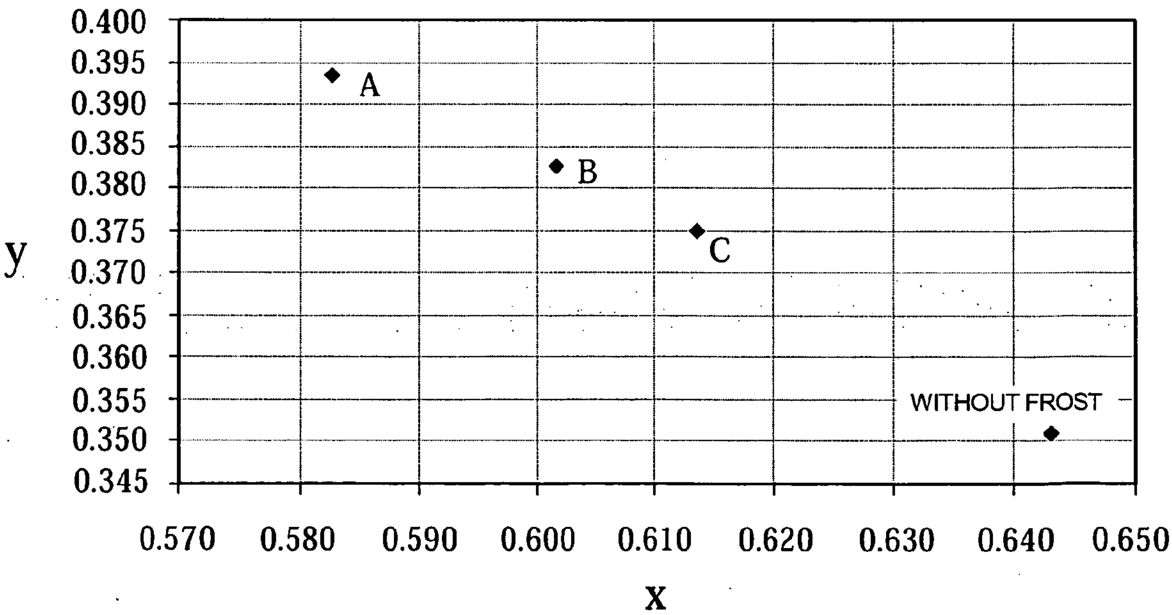

FIG.6

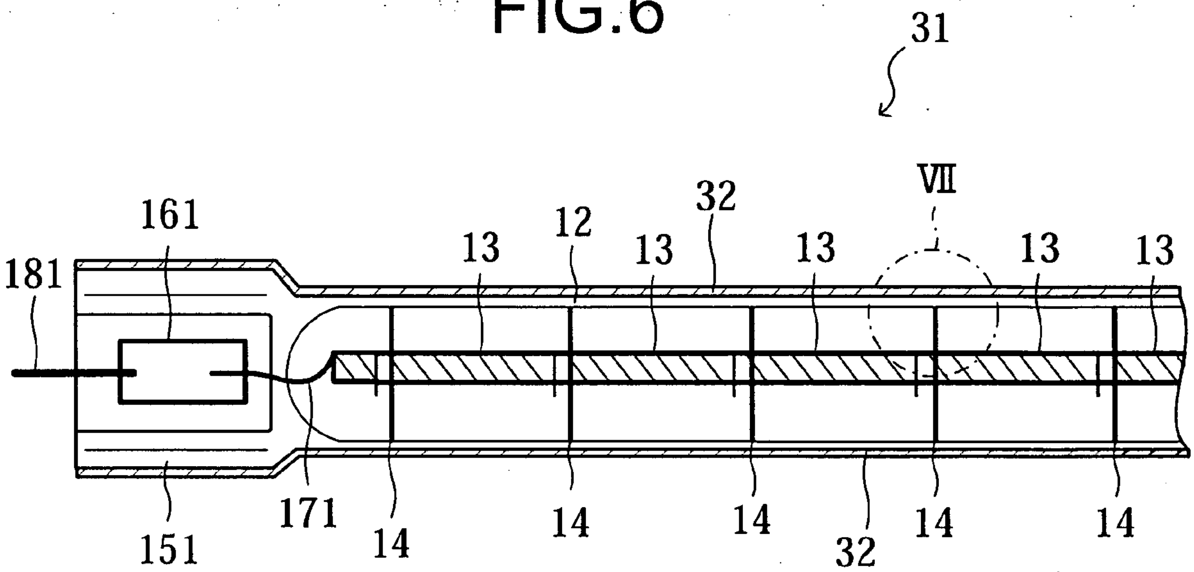

FIG.7