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(71) Applicant:
Matsushita Electric Industrial Co., Ltd.
Kadoma-shi, Osaka 571-8501 (JP)

(72) Inventors:
- **OHKUBO, Kazuaki**
  Takatsuki-shi Osaka 569-1142 (JP)
- **INOHARA, Makoto**
  Katano-shi Osaka 576-0014 (JP)
- **YANO, Tadashi**
  Kizucho, Soraku-gun Kyoto 619-0223 (JP)
- **SHIGETA, Teruaki**
  Ichibankan, Okuhiruzukouri
  Neyagawa-shi Osaka 572-0019 (JP)

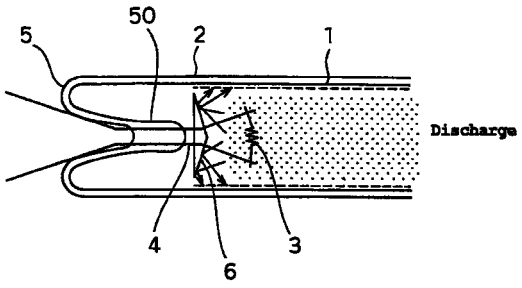
(74) Representative:
Grünecker, Kinkeldey,
Stockmair & Schwanhäusser
Anwaltssozietät
Maximilianstrasse 58
80538 München (DE)

(54) FLUORESCENT LAMP

(57) A fluorescent lamp has:

a glass tube with an inner wall on which a phosphor is applied and in which metallized steam and rare gas are sealed;
discharge electrodes provided at both ends of the glass tube;
electrode leads for supporting the discharge electrodes and supplying power to the discharge electrodes from the external part of the tube; and
reflectors provided between the tube end sealing parts of the tube end parts of the glass tube and the discharge electrodes,
characterized in that the reflectors reflect the radiation and light components directed toward the tube end parts of the radiation resulting from the discharge generated in the glass tube and light excited and emitted by the phosphor due to the radiation on the inside of the glass tube.

Fig. 1



1: Phosphor
2: Glass tube
3: Discharge electrode
4: Electrode lead
5: Tube end part
6: Diffuse reflector

EP 1 063 680 A1

Description

Technical Field

[0001] The present invention relates to a fluorescent lamp capable of realizing the improvement of a luminous efficacy of lamp.

Background Art

[0002] A fluorescent lamp employed for lighting has a problem to improve its luminous efficacy. The luminous efficacy of the fluorescent lamp has been enhanced by improving the quantum efficiency of a phosphor or developing a high frequency operation technique, however, it is almost reaching its limitation.

[0003] The electrode parts of the fluorescent lamp generate a large quantity of radiation of 254 nm for exciting the phosphor. Figure 3 shows a result obtained when a germicidal lamp of GL20 is used to measure the distribution of the radiation of 254 nm in the axial direction of its tube. At the same time, the luminous distribution of a fluorescent lamp FL20SSEXD is shown in Figure 3. As apparent from the figure, a large quantity of the radiation of 254 nm not lower than that of the discharge of a positive column part is generated in the vicinity of both electrodes in the right and left sides of the fluorescent lamp (low pressure mercury discharge lamp).

[0004] However, in the radiation of the electrode parts, the radiation directed toward tube end parts in the radiation of 254 nm generated in the electrode parts is absorbed in the tube end parts as shown in Figure 7, and therefore, it does not contribute to the emission of fluorescent light. Further, in the emission of fluorescent light from the phosphor applied to the wall of a glass tube, the light directed toward the tube end parts is absorbed in the vicinity of the tube end parts, so that it does not form the luminous fluxes of the lamp. The inventor of the present invention found such problems.

[0005] The radiation of 254 nm or the emission of fluorescent light which does not contribute to these luminous fluxes is efficiently taken out from the lamp as the luminous fluxes of the lamp, so that it can be expected to improve the luminous fluxes. However, since currently employed fluorescent lamps are extremely highly popularized and a demand for replacing them by other fluorescent lamps is also increased, it has been necessary to enhance the luminous efficacy of the fluorescent lamp without changing the appearance and configuration of the lamp, the specification of an electrode socket and electric characteristics.

Disclosure of Invention

[0006] It is an object of the present invention to provide a fluorescent lamp in which the above described problems can be solved.

[0007] The present invention is a fluorescent lamp comprising:

a glass tube with an inner wall on which a phosphor is applied and in which metallized steam and rare gas are sealed;
discharge electrodes provided at both ends of the glass tube;
electrode leads for supporting said discharge electrodes and supplying power to said discharge electrodes from the external part of the tube; and
reflectors provided between the tube end sealing parts of the tube end parts of said glass tube and said discharge electrodes,
characterized in that said reflectors reflect the radiation and light components directed toward said tube end parts of the radiation resulting from the discharge generated in said glass tube and light excited and emitted by said phosphor due to the radiation on the inside of said glass tube.

[0008] Further, the present invention is a fluorescent lamp comprising:

a glass tube with an inner wall on which a phosphor is applied and in which metallized steam and rare gas are sealed;
discharge electrodes provided at both ends of the glass tube; electrode leads for supporting said discharge electrodes and supplying power to said discharge electrodes from the external part of the tube; and
fluorescent screens provided between the tube end sealing parts of the tube end parts of said glass tube and said discharge electrodes,
characterized in that said fluorescent screens emit light by radiation components directed toward said tube end parts within the radiation resulting from the discharge generated in said glass tube, and reflect light components directed toward said tube end parts within the light generated in said glass tube.

[0009] Further, the present invention is a fluorescent lamp comprising:

a glass tube with an inner wall on which a phosphor is applied and in which metallized steam and rare gas are sealed;
discharge electrodes provided at both ends of the glass tube; and
electrode leads for supporting said discharge electrodes and supplying power to said discharge electrodes from the external part of the tube,
characterized in that the parts of the tube end sealing parts of the tube end parts of said glass tube directed toward said discharge electrode sides are provided with reflection surfaces capable of reflect-

ing said radiation and/or light.

[0010] Further, the present invention is a fluorescent lamp comprising:

a glass tube with an inner wall on which a phosphor is applied and in which metallized steam and rare gas are sealed;
discharge electrodes provided at both ends of the glass tube; and
electrode leads for supporting said discharge electrodes and supplying power to said discharge electrodes front the external part of the tube,
characterized in that fluorescent materials are applied to parts of the tube end sealing parts of the tube end parts of said glass tube directed toward said discharge electrode sides.

[0011] According to the present invention, the luminous fluxes or radiant fluxes of the fluorescent lamp can be improved with the same electric characteristics as those of a conventional fluorescent lamp by the above described means and the improvement of luminous efficacy of the lamp can be realized.

Brief Description of the Drawings

[0012]

Figure 1 is a configuration view of a part in the vicinity of an electrode of a fluorescent lamp according to Embodiment 1 of the present invention;
Figure 2 is a configuration view of a part in the vicinity of an electrode of a fluorescent lamp according to Embodiment 2 of the present invention;
Figure 3 is a view showing luminous distribution in the axial direction of GL220 and the fluorescent lamp;
Figure 4 is a configuration view of a part in the vicinity of an electrode of a fluorescent lamp according to Embodiment 4 of the present invention;
Figure 5 is a process view for explaining a method for manufacturing the fluorescent lamp according to Embodiment 4 of the present invention;
Figure 6 shows sectional views illustrating the various kinds of the forms of parts directed toward a discharge electrode side in the embodiments of the present invention; and
Figure 7 is a configuration view of a conventional fluorescent lamp.

(Description of Symbols)

[0013]

1	Phosphor
2	Glass tube
3	Discharge electrode
4	Electrode lead
5	Tube end part
6	Diffuse reflector
7	Fluorescent screen
50	Sealing part of tube end part
50a.	Sealing part main body
50b.	Part directed toward the discharge electrode side of sealing part

Best Mode for Carrying Out the Invention

[0014] Now, referring to the accompanying drawings, embodiments of the present invention will be described.

(Embodiment 1)

[0015] In Figure 1, a configuration view of Embodiment 1 of the present invention is shown.

[0016] Referring to Figure 1, both the tube end parts 5 (in Figure 1, only its left side is shown) of a glass tube 2 with an inner part to which a phosphor 1 is applied have sealing parts 50 protruding to the inside part in view of manufacture. Electrode leads 4 pass through the sealing part 50 and extend from the outside to the inside of the tube. A discharge electrode 3 is attached to the inner ends of the electrode leads 4. The electrode leads 4 serve to support the discharge electrode 3 and feed electric current to the electrode 3 located in the tube from outside the tube.

[0017] Further, the electrode leads 4 located between the sealing part 50 and the discharge electrode 3 are provided with a diffuse reflector 6. Metallized steam and rare gas are sealed therein to configure the fluorescent lamp.

[0018] This diffuse reflector 6 is manufactured in such a manner that a material with high reflectance located within a range from a visible radiation area to an ultraviolet radiation spectral area such as $BaSO_4$ or TiO_3 is applied to a material with no electric conductivity similarly to a glass plate or a ceramic plate and capable of withstanding high temperature upon manufacture of the fluorescent lamp.

[0019] The radiation due to discharge generated in the glass tube 2 and the emission of light of the phosphor 1 due to the radiation are reflected in the tube and the components of the radiation and the light thereof directed toward each of the tube end parts 5 are reflected on the inside of the glass tube 2 by the diffuse reflector 6, so that luminous fluxes and radiant fluxes are improved.

(Embodiment 2)

[0020] Figure 2 shows a configuration of Embodiment 2 of the present invention.

[0021] Referring to Figure 2, both the tube end parts 5 (in Figure 1, only a left side is shown) of a glass

tube 2 with an inner part to which a phosphor 1 is applied have sealing parts 50 protruding to the inside part in view of manufacture. Electrode leads 4 pass through the sealing part 50 and extend from the outside to the inside of the tube. A discharge electrode 3 is attached to the inner ends of the electrode leads 4. The electrode leads 4 serve to support the discharge electrode 3 and feed electric current to the electrode 3 located in the tube from outside the tube.

[0022] Further, the electrode leads 4 located between the sealing part 50 and the discharge electrode 3 are provided with a fluorescent screen 7. Metallized steam and rare gas are sealed therein to configure the fluorescent lamp.

[0023] This fluorescent screen 7 is manufactured in such a manner that the phosphor is applied or stuck to a material with no electric conductivity similarly to a glass plate or a ceramic plate and capable of withstanding high temperature upon manufacture of the fluorescent lamp.

[0024] The radiation of ultraviolet rays for exciting the phosphor such as 254 nm and 185 nm, etc. which are radiated toward each of the tube end parts 5 after the discharge of the discharge electrode 3 causes the fluorescent screen 7 to emit light. Further, the radiation caused by the discharge generated in the glass tube 2 causes the phosphor 1 applied to the wall of the glass tube 2 to emit light. The components of emitted light directed toward to each of the tube end parts 5 are reflected on the inside of the glass tube by the fluorescent screen 7, so that luminous fluxes or radiant fluxes are increased.

[0025] Actually, a lamp was manufactured, in which to the electrode leads 4 of a FL20SSEXD fluorescent lamp was attached the fluorescent screen 7 on which the same phosphor for EXD was applied. At this time, the fluorescent screen 7 was fixed to a position spaced by 10 to 15 mm from the discharge electrode 3 toward the tube end part 5.

[0026] A lamp having the fluorescent screen 7 and a lamp (conventional lamp) having no fluorescent screen were manufactured at the same time and the characteristics of them are compared with each other by lighting the lamps under the lamp power of 18W. As a consequence, results obtained indicated that the tube voltage and the tube current of the lamp are substantially equal and the luminous fluxes are improved by 2.3 %.

(Embodiment 3)

[0027] Embodiment 3 of the present invention will be described below. According to the configuration of Embodiment 3, a phosphor 1 applied to a glass tube 2 is intentionally made to be different from that applied to a fluorescent screen 7 of Embodiment 2.

[0028] The FL20SSEXD fluorescent lamp illustrated in Embodiment 2 is a three band radiation type fluorescent lamp. Three kinds or more of phosphors are mixed and the mixture is applied to this lamp. Thus, the phosphor of the fluorescent screen 7 may be changed in various ways relative to the fluorescent lamp with the same mixing ratio, so that the color of the entire body of the lamp can be adjusted with ease.

(Embodiment 4)

[0029] Figure 4 shows Embodiment 4 of the present invention. In this embodiment, a part 50b of the tube end sealing part 50 of a tube end part 5 directed toward the side of a discharge electrode 3 is formed in the shape of a disk. The disk shaped part 50b has thickness larger than that of the main body part 50a of the sealing part 50.

(Embodiment 3)

[0030] Further, in the embodiment shown in Figure 4, the size of the disk shaped part 50b is substantially the same as that of a section in a glass tube 2.

[0031] On the surface of the disk shaped part 50b, the material of the diffuse reflector or the material of the fluorescent screen described in Embodiments 1 and 2 are formed. The radiant fluxes and the luminous fluxes as described in Embodiments 1 and 2 can be improved by the part 50b.

[0032] Now, a method for forming such a disk shaped part 50b will be described.

[0033] In Figure 5, initially, a member for forming a tube end part 5 is manufactured. In other words, a glass tube 20 with both ends opened is prepared (a). Both the ends of the glass tube 20 are conically expanded (b). A thin glass tube 21 and electrode lead materials 22 are inserted into the glass tube 20 (c). Then, while a flat die 23 (a through hole is formed at its center and the ends of the electrode lead materials 22 escape therein) abuts on one side of the glass tube 20 and another die 24 presses the central part of the glass tube 20 to throttle or restrict the center of the glass tube 20 and fuse it into the thin glass tube 21. At that time, since the one end part of the thin glass tube 21 is sealed and air is supplied from the other end thereof, a hole 25 is formed on a side part. As a result, a disk shaped surface 26 is formed in the part of the glass tube 20 on which the die 23 abuts. Then, the discharge electrode is attached to the ends of the electrode leads 22.

[0034] The member for forming the tube end part 5 is embedded and melted into the end of the glass tube of a separately prepared fluorescent lamp with the discharge electrode 3 located inside. Thus, the fluorescent lamp according to Embodiment 4 can be formed.

[0035] In this case, the above described die 23 is formed in various kinds of shapes, so that the disk shaped part 26 can be formed in a variety of shapes.

[0036] The shapes of the reflector, the fluorescent screen and the part directed toward the discharge elec-

trode side of the present invention are not limited to those described in the above described embodiments, various kinds of shapes as shown in Figure 6 may be employed. Briefly stated, the above members may have such shapes as to prevent the radiation or light components directed to the tube end part 5 from being directly turned to and absorbed by the tube end part 5.

[0037] Figure 6(a) shows a type with a surface on which many protrusions are formed. Figure 6(b) shows a type with a surface on which many irregularities or protrusions and recesses formed and Figure 6(c) shows a type with a concave surface.

Industrial Applicability

[0038] As described above, according to the present invention, the luminous fluxes of the fluorescent lamp can be improved with the same electric characteristics as those of the conventional fluorescent lamp and the improvement of the luminous efficacy of a lamp can be realized.

Claims

1. A fluorescent lamp comprising:

a glass tube with an inner wall on which a phosphor is applied and in which metallized steam and rare gas are sealed;
discharge electrodes provided at both ends of the glass tube;
electrode leads for supporting said discharge electrodes and supplying power to said discharge electrodes from the external part of the tube; and
reflectors provided between the tube end sealing parts of the tube end parts of said glass tube and said discharge electrodes,
characterized in that said reflectors reflect the radiation and light components directed toward said tube end parts of the radiation resulting from the discharge generated in said glass tube and light excited and emitted by said phosphor due to the radiation on the inside of said glass tube.

2. A fluorescent lamp comprising:

a glass tube with an inner wall on which a phosphor is applied and in which metallized steam and rare gas are sealed;
discharge electrodes provided at both ends of the glass tube; electrode leads for supporting said discharge electrodes and supplying power to said discharge electrodes from the external part of the tube; and
fluorescent screens provided between the tube end sealing parts of the tube end parts of said glass tube and said discharge electrodes,
characterized in that said fluorescent screens emit light by radiation components directed toward said tube end parts within the radiation resulting from the discharge generated in said glass tube, and reflect light components directed toward said tube end parts within the light generated in said glass tube.

3. The fluorescent lamp according to claim 1 or 2, characterized in that said fluorescent screens have a different kind of phosphor material from a phosphor material applied to the inner part of said glass tube.

4. The fluorescent lamp according to claim 1 or 2, characterized in that said fluorescent screens have the same kind of phosphor material as the phosphor material applied to the inner part of said glass tube.

5. The fluorescent lamp according to claim 1, characterized in that said reflectors or said fluorescent screens are formed in conical or domed shapes arranged so that their axes substantially correspond to the axis of said glass tube, or a plurality of irregularities or protrusions and recesses are formed on the surfaces thereof, or a plurality of protrusions are formed on the surfaces thereof.

6. A fluorescent lamp comprising:

a glass tube with an inner wall on which a phosphor is applied and in which metallized steam and rare gas are sealed;
discharge electrodes provided at both ends of the glass tube; and
electrode leads for supporting said discharge electrodes and supplying power to said discharge electrodes from the external part of the tube,
characterized in that the parts of the tube end sealing parts of the tube end parts of said glass tube directed toward said discharge electrode sides are provided with reflection surfaces capable of reflecting said radiation and/or light.

7. A fluorescent lamp comprising:

a glass tube with an inner wall on which a phosphor is applied and in which metallized steam and rare gas are sealed;
discharge electrodes provided at both ends of the glass tube; and
electrode leads for supporting said discharge electrodes and supplying power to said discharge electrodes from the external part of the tube,

characterized in that fluorescent materials are applied to parts of the tube end sealing parts of the tube end parts of said glass tube directed toward said discharge electrode sides.

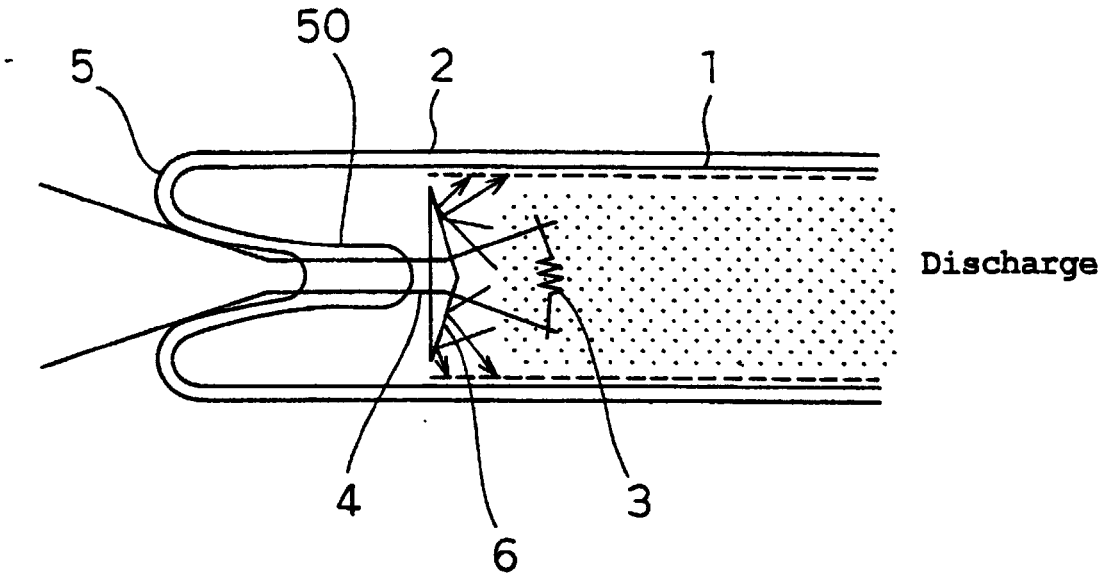
8. The fluorescent lamp according to claim 6 or 7, characterized in that the parts of said tube end sealing parts directed toward said discharge electrode sides are formed in disk shapes the thickness of which is larger than that of the main body parts of the tube end sealing parts.

9. The fluorescent lamp according to claim 6 or 7, characterized in that the parts of said tube end sealing parts directed toward said discharge electrode sides are formed in disk shapes having the size substantially equal to that of the inner longitudinal section of said glass tube.

10. The fluorescent lamp according to any one of claims 6 to 9, characterized in that the parts of the tube end sealing parts of said glass tube directed toward said discharge electrode sides are formed in conical or domed shapes arranged so that their axes substantially correspond to the axis of said glass tube, or a plurality of irregularities or protrusions and recesses are formed on the surfaces thereof, or a plurality of protrusions are formed on the surfaces thereof.

11. The fluorescent lamp according to claim 6 or 7, characterized in that the parts of said tube end sealing parts directed toward said discharge electrode sides are formed in disk shapes of size smaller than that of the inner longitudinal section of said glass tube.

Fig. 1



1: Phosphor

2: Glass tube

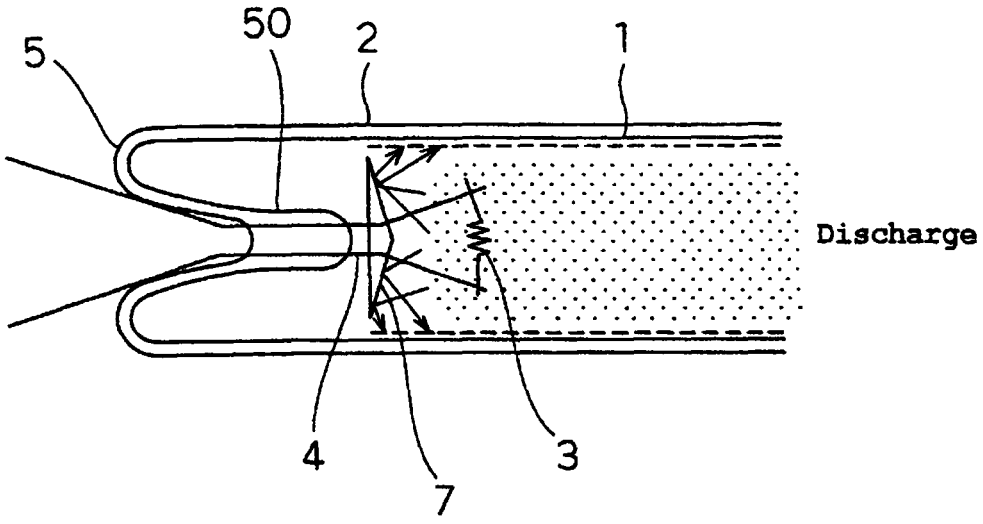
3: Discharge electrode

4: Electrode lead

5: Tube end part

6: Diffuse reflector

Fig. 2



1: Phosphor

2: Glass tube

3: Discharge electrode

4: Electrode lead

5: Tube end part

7: Fluorescent screen

Fig. 3

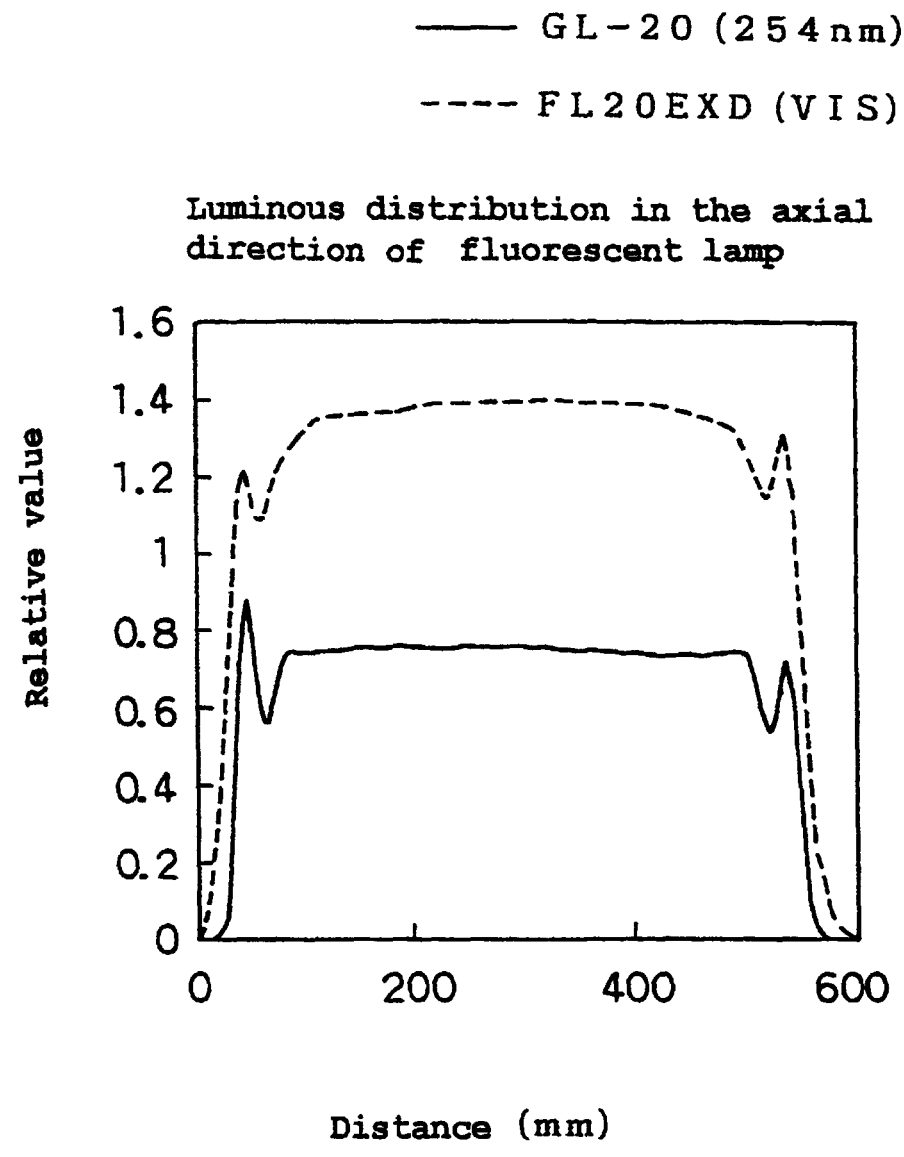
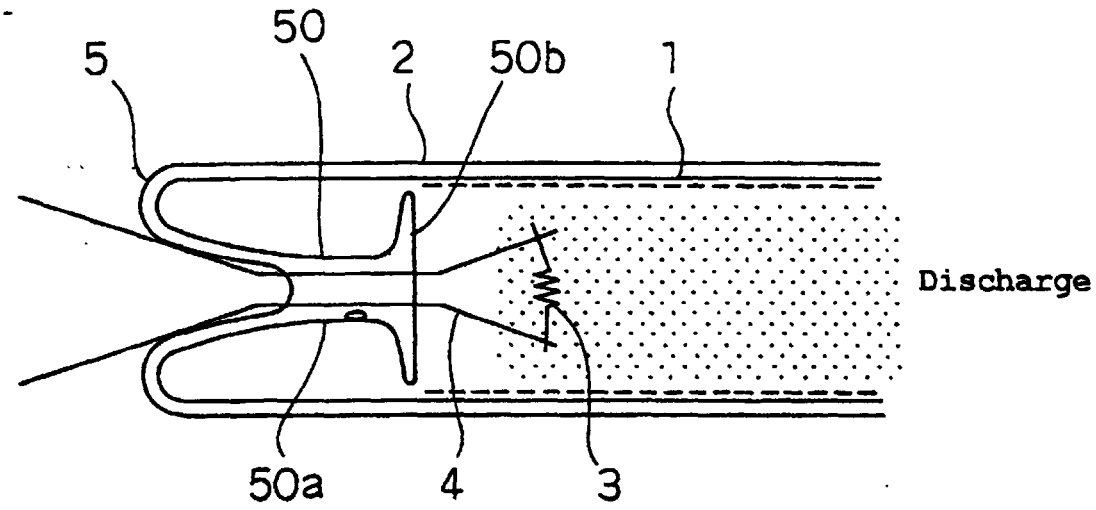

GL-20 (254nm)
FL20EXD (VIS)
Luminous distribution in the axial direction of fluorescent lamp
Relative value
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
200
400
600
Distance (mm)

Fig. 4



1: Phosphor

2: Glass tube

3: Discharge electrode

4: Electrode lead

5: Tube end part

Fig. 5 (a)

Fig. 5 (b)

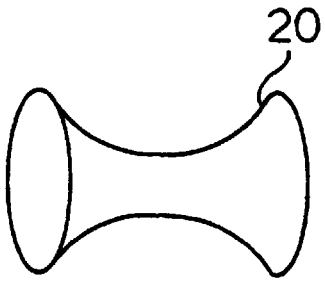


Fig. 5 (c)

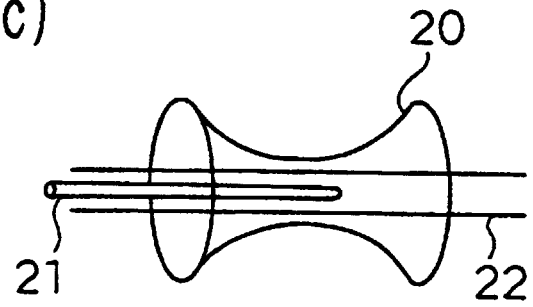


Fig. 5 (d)

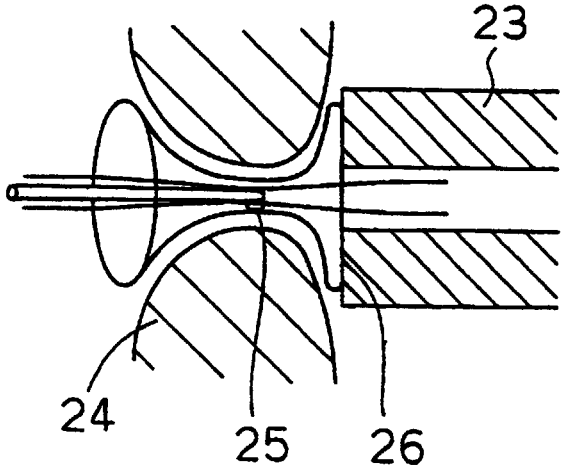


Fig. 6 (a)

Fig. 6 (b)

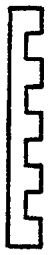
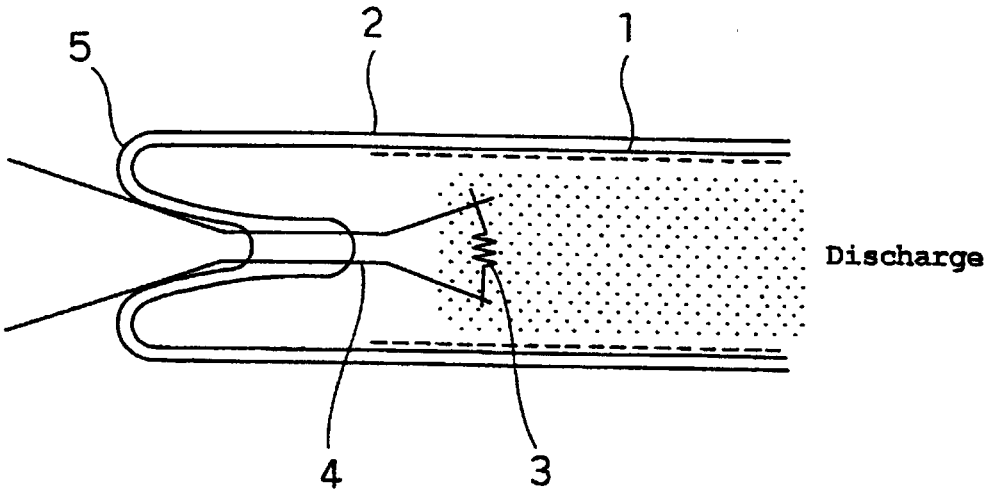


Fig. 6 (c)

Fig. 7



1: Phosphor

2: Glass tube

3: Discharge electrode

4: Electrode lead

5: Tube end part

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/01238

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[6] H01J61/10, 61/35, 61/42

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[6] H01J61/10, 61/35, 61/42

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1940-1996 Toroku Jitsuyo Shinan Koho 1994-1999
Kokai Jitsuyo Shinan Koho 1971-1999 Jitsuyo Shinan Toroku Koho 1996-1999

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 39-19440, Y1 (Hitachi Rampu K.K.), 9 July, 1964 (09. 07. 64), Full text ; all drawings (Family: none)	1-5
X	JP, 28-10389, Y1 (Mitsubishi Electric Corp.), 20 October, 1953 (20. 10. 53), Full text ; all drawings	6
Y	Page 1, right column, lines 16, 17, 23, 24	1-5
A	Full text ; all drawings (Family: none)	8-9
Y	JP, 62-177858, A (Toshiba Denzai K.K.), 4 August, 1987 (04. 08. 87), Page 1, lower right column, lines 11, 12 (Family: none)	5

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 June, 1999 (08. 06. 99)	15 June, 1999 (15. 06. 99)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/01238

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 60-108318 (Laid-open No. 62-17059) (Mitsubishi Electric Corp.), 31 January, 1987 (31. 01. 87),	
X	Full text ; Figs. 1, 2	7, 11
A	Full text ; Figs. 1, 2 (Family: none)	8-9
	JP, 7-21991, A (Noritake Co., Ltd.), 24 January, 1995 (24. 01. 95),	
X	Full text ; all drawings	7, 10
A	Full text ; all drawings (Family: none)	8-9

Form PCT/ISA/210 (continuation of second sheet) (July 1992)