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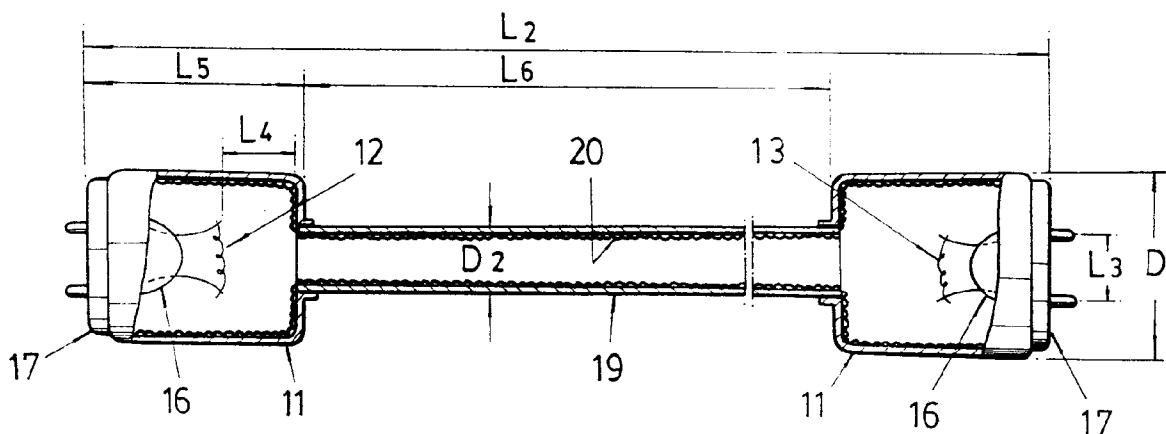
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(54) **Fluorescent lamp.**

(57) A fluorescent lamp comprises a respective glass drum (11) attached to each end of a glass tube (19). Each drum (11) has a diameter (D_1) larger than that of a conventional glass tube so as to improve cooling efficiency and reduce the effect of the black conversion phenomenon, and the glass tube has a diameter smaller than that of a conventional glass tube so as to reduce the self-absorption rate of ultraviolet radiation. The inside surface of the drums (11) and the glass tube (19) are coated with a thin film of fluorescent material (20).

FIG 2



The present invention relates to fluorescent lamps.

In general, luminous sources for illumination comprise incandescent lamps and electrical discharge lamps such as fluorescent lamps, mercury lamps and high-voltage sodium lamps. Fluorescent lamps are, however, preferred for domestic lighting.

A conventional linear fluorescent lamp, as shown in Fig. 1, comprises a transparent glass tube (1) of length $L_2 = 1198$ mm to each end of which is attached a respective base (5), having a diameter $D = 28$ mm and being provided with two terminal pins (10) separated by a distance $L_1 = 12$ mm.

The transparent glass tube (1) is coated on the inside with a thin film of fluorescent material (2), the base (5) and the terminal pin (10) are provided at both ends of the glass tube (1) and two electrodes (3) and (4) coated with electron radiation material are each provided in the form of a double coil of tungsten filament. The glass tube is energised with AC voltage. Thus, at any time, one of the electrodes (e.g. 3) is a negative electrode while the other electrode (4) is positive.

The glass tube (1) is filled with mercury vapour and either argon or krypton at a few mmHg pressure in order to facilitate discharge.

In order to energise the conventional linear fluorescent lamp, an appropriate voltage is applied between the pins (10) in the two bases (5) of the glass tube, i.e. between the negative electrode (3) and the positive electrode (4).

At the same time, an electric current is caused to flow in the filament of the negative electrode (3) in the glass tube, to cause pre-heating, so as to generate thermionic emission of electrons, which are then attracted to the filament of the positive electrode (4) by the electric field, and the discharge then takes place. An electron (6) resulting from the discharge strikes a mercury atom (7) of the mercury which is vaporised as a result of the rise in temperature in the glass tube (1) and excites the mercury atom (7) so as to cause ultraviolet radiation to be radiated to the side walls of the glass tube (1).

Since the side walls of the glass tube (1) are coated with a thin film of fluorescent material (2), the ultraviolet radiation is absorbed by this and converted into visible light (9) which is emitted from the lamp.

However, in the above-described process, the ultraviolet radiation (8) emitted by the excited mercury atom (7) in the glass tube (1) may be absorbed by another mercury atom before arriving at the thin film of fluorescent material (2), especially if the distance between the excited mercury atom (7) and the wall of the glass tube is large. It is therefore desirable that the diameter D of the glass tube (1) be sufficiently small so as to reduce significantly this self-absorption.

However, if the full length (L_2) of the glass tube

(1) is maintained while at the same time reducing the diameter, the fluorescent material (2) coated on the inside wall of the glass tube (1) becomes overheated and, as a result of the temperature dependence of the fluorescent material (2), the intensity of the visible light emitted is reduced.

In addition, the electron radiation material coated on the filament of the negative electrode (3) becomes slowly dispersed as a result of high-energy positive ions in the glass tube (1) colliding with the filament of the negative electrode (3) at the end of the glass tube at the time of the initial energisation of the conventional fluorescent lamp. The dispersed electron radiation material is then absorbed in the side wall surrounding the negative electrode filament, and this gives rise to an effect known as the black conversion phenomenon. If this occurs over a prolonged time, the resulting area of blackness increases on the side wall of the glass tube (1).

This results in the affected part of the glass tube (1) becoming conductive and not only impedes the discharge, but reduces the intensity of the visible light emitted at that part.

Furthermore, dispersal of the electron radiation material reduces the number of electrons emitted from the filament and also raises the starting discharge voltage, resulting in a reduced level of light and a reduced lifetime of the fluorescent tube.

It would therefore be desirable to provide a fluorescent lamp wherein the above-mentioned self-absorption effect is reduced and, at the same time, wherein the black conversion phenomenon at the end of the glass tube and the temperature rise of the glass tube are both reduced.

In accordance with a first aspect of the present invention, there is provided a fluorescent lamp comprising two end sections which house respective electrodes and a tubular central section, the end sections having a substantially larger cross-sectional area than that of the central section.

The ratio of the cross-sectional area of the end sections to the cross-sectional area of the central section is preferably in the range 2.0 to 4.0, and a ratio of 2.5 is especially preferred.

In accordance with a second aspect of the present invention, there is provided a method of manufacturing a fluorescent lamp comprising joining two end sections to respective ends of a tubular central section, the end sections having a substantially larger cross-sectional area than that of the central section, and depositing a layer of fluorescent material on the interior surface of the resulting structure.

Preferred embodiments of the invention will now be described with reference to the accompanying drawings, wherein:

Fig. 1 is a longitudinal sectional view of the internal structure of a conventional linear fluorescent lamp;

Fig. 2 is a longitudinal sectional view of a linear fluorescent lamp in accordance with an embodiment of the present invention;

Fig. 3 is a partial sectional view of the fluorescent lamp illustrated in Fig. 2;

Fig. 4 is a perspective view of the fluorescent lamp illustrated in Fig. 2; and

Figs. 5A, 5B are representations of fluorescent lamps having a circular-shape and a U-shape respectively, in accordance with further embodiments of the present invention.

Referring to Fig. 2, the fluorescent lamp is so formed that the diameter of the narrow glass tube (19) forming the central part of the lamp is in the range 20 to 25 mm and therefore less than the diameter D of the above-described conventional glass tube (28 mm) so as to reduce the self-absorption rate of ultraviolet radiation emitted from the central area, thereby to increase the luminous efficiency. The preferred diameter of the narrow glass tube (19) is 24 mm. In addition, the cooling is improved by the provision of a glass drum (11) at each end of the central part, having a diameter D_1 in the range 35 to 40 mm and therefore considerably larger than the diameter D of the conventional glass tube, and the temperature rise in the narrow glass tube (19) is thereby suppressed.

The dispersal of the coating of electron radiation material, such as barium oxide, on the negative electrode (12) filament can be reduced because sufficient space can be provided between the side wall (C_1) of the glass drum (11) and the negative electrode (12) as shown in Fig. 3.

The dispersal can be quantified as a dispersing speed defined by $V_e/P.d$ (where V_e is the negative electrode voltage, P is the gas pressure and d is the distance from the negative electrode), and this is clearly inversely proportional to the distance between the negative electrode (12) and the glass drum (11) wall. Consequently, as the distance between the negative electrode and the glass drum is increased, the black conversion effect is reduced.

The glass drum (11) shown in Fig. 3 is a cylindrical tube having a diameter $D_1 = 38$ mm, which is larger than the diameter D (28 mm) of the glass tube shown in Fig. 1. It has an opening (B_1) which is bent slightly inwardly, in which a base (17), having two pins (18) spaced by an interval $L_3 = 12$ mm, is easily inserted and attached.

The glass drum (11) has a further opening (C_3) in which the narrow glass tube (19) is inserted, and on the periphery of which a projection or collar (B_2) is formed so as to facilitate location of the narrow glass tube (19) during manufacture.

During manufacture, a respective glass drum (11) is inserted in and attached to each side of the narrow glass tube (19), as shown in Fig. 4, and then the fluorescent material of the thin film is coated on the in-

ner wall of the narrow glass tube (19) and the walls of both glass drums (11).

A first base (17) and either the negative electrode (12) or the positive electrode (13) are then attached to the opening (B_1) of one of the glass drums (11). The wing parts (A, Fig. 3) of the respective electrodes are attached to electrode stems which are wider than the stems in conventional fluorescent lamps.

The entire structure is evacuated, and mercury and an inert gas are introduced. The second base (17) is then attached to the other glass drum (11), thereby completing the manufacture of the fluorescent lamp.

The fluorescent lamp has an overall length of $L_2 = 1198$ mm (where $L_2 = 2L_5 + L_6$ and $L_2 > L_6 > 2L_5$; see Figure 2), which is the same as the overall length of the conventional fluorescent lamp. In the preferred embodiment, $L_2 = 1198$ mm, $L_5 = 100$ mm and $L_6 = 998$ mm. The glass drum (11) has a length L_5 , and most of the black conversion effect occurs here. The interval between the pins (18) of each base (17) is L_3 , and, by making this the same as that (L_4) in conventional lamps, i.e. 12 mm, it is possible to interchange the fluorescent lamp with conventional fluorescent lamps.

In the glass drum (11), the distance between the filament of the negative electrode (12) and the side wall is greater than that of the conventional lamp shown in Fig. 1. Consequently, the dispersal of the electron radiation material generated with the filament of the conventional negative electrode is reduced.

Although a fluorescent lamp has been described having a linear glass tube, such a feature is not essential, and, as shown in Figs. 5A and 5B, the glass tube (19) can alternatively be formed as a circular shape or a U-shape.

The lighting operation of the above-described fluorescent lamp will now be explained. In order to energise the fluorescent lamp, the appropriate voltage is applied between the negative electrode (12) and the positive electrode (13) by suitable connection of an electricity supply to the pins (18) in the bases (17) of the glass tube, but the electrical phenomena are the same as in conventional fluorescent lamps, and so a detailed explanation of the lighting operation will be omitted. Only the effects resulting from the narrow glass tube (19) and the wide glass drums (11) will be explained.

First of all, the luminous efficiency is improved because the self-absorption of ultraviolet radiation is reduced in the tube by making the diameter D_2 of the glass tube smaller than the diameter D of the conventional glass tube.

Furthermore, the heat from the fluorescent material coating the wall of the narrow glass tube is conducted to the glass drums (11), and these have a diameter D_2 which is greater than the diameter D of the conventional glass tube, so that a cooling effect is

provided by this large surface area. In order for high luminous efficiency to be achieved, it is desirable that ultraviolet radiation having a wavelength of 253.7 nm be produced. However, such emission depends upon the vapour pressure of the mercury, which itself is temperature-dependent. With the structure of the lamp in accordance with the present invention, the gas pressure in the narrow glass tube (19) and the glass drums (11) can be controlled effectively because the volume of the drums (11) at both ends of the narrow glass tube (19) is made relatively large.

The dispersing phenomenon of radiation material from the filament of the negative electrode (12) in the glass drum (11) can reduce the black conversion effect occurring in the vicinity of the filament of the negative electrode (12), because the volume of the end portions of the tube is increased owing to the glass drum having a diameter D_2 greater than that of the conventional glass tube. Accordingly, the fluorescent lamp of the present invention can have an increased life by reducing the black conversion in the glass drum (11) and the consequential lowering of the luminous efficiency.

The heat loss resulting from the heat radiated from the negative electrode (12) is reduced because of the increased distance between the filament of the negative electrode (12) in the glass drum (11) and the wall of the drum, and the thermal efficiency of the fluorescent lamp can be improved because the temperature rise of the glass drum (11) having a large diameter D_1 is reduced. Accordingly, the luminous efficiency can be increased, the black conversion effect can be reduced, the self-absorption rate of ultraviolet radiation in the center of the narrow glass tube (19) can be reduced and the temperature rise of the central part can be restrained.

Claims

1. A fluorescent lamp comprising two end sections (11) which house respective electrodes (12, 13) and a tubular central section (19), the end sections (11) having a substantially larger cross-sectional area than that of the central section (19).
2. A fluorescent lamp as claimed in claim 1, wherein the ratio of the cross-sectional area of the end sections (11) to the cross-sectional area of the central section (19) is in the range 2.0 to 4.0.
3. A fluorescent lamp as claimed in claim 1 or claim 2, wherein the length (L_6) of the central section (19) is greater than the length (L_5) of each end section (11).
4. A fluorescent lamp as claimed in claim 3, wherein

the length (L_6) of the central section (19) is greater than twice the length (L_5) of each end section (11).

5. A fluorescent lamp as claimed in claim 4, wherein the length (L_6) of the central section (19) is approximately ten times the length (L_5) of each end section (11).
6. A fluorescent lamp as claimed in any preceding claim and having a generally elongate shape.
7. A fluorescent lamp as claimed in any one of claims 1 to 5 and having a generally circular shape.
8. A fluorescent lamp as claimed in any one of claims 1 to 5 and being substantially U-shape.
9. A fluorescent lamp as claimed in any preceding claim, wherein each end section (11) is provided with a collar (B_2) for facilitating its connection to the central section (19) during manufacture.
10. A fluorescent lamp as claimed in any preceding claim, wherein the end sections (11) are substantially circularly cylindrical.
11. A fluorescent lamp as claimed in claim 10, wherein the diameter of the end sections (11) is in the range 35 to 40 mm.
12. A fluorescent lamp as claimed in any preceding claim, wherein the tubular central section (19) has a diameter in the range 20 to 25 mm.
13. A method of manufacturing a fluorescent lamp comprising joining two end sections (11) to respective ends of a tubular central section (19), the end sections (11) having a substantially larger cross-sectional area than that of the central section (19), and depositing a layer of fluorescent material (20) on the interior surface of the resulting structure.

FIG 1

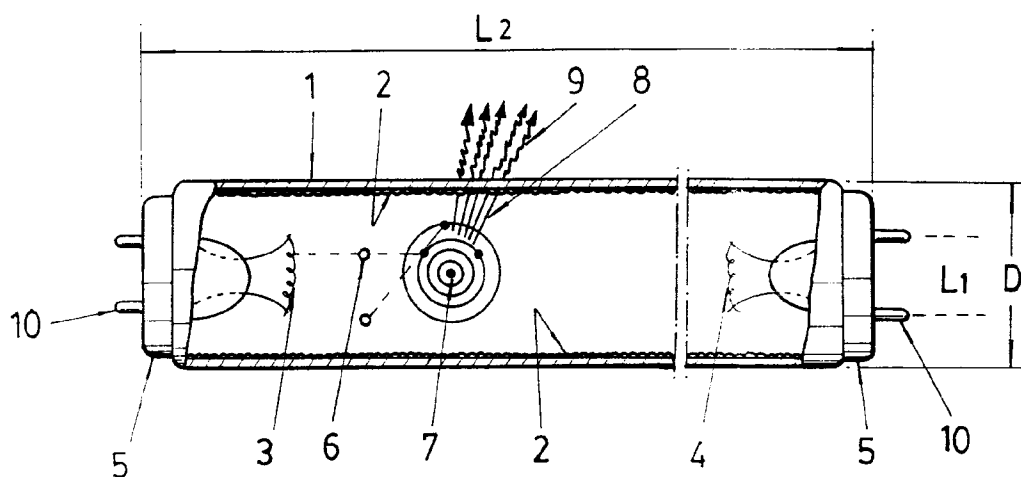


FIG 2

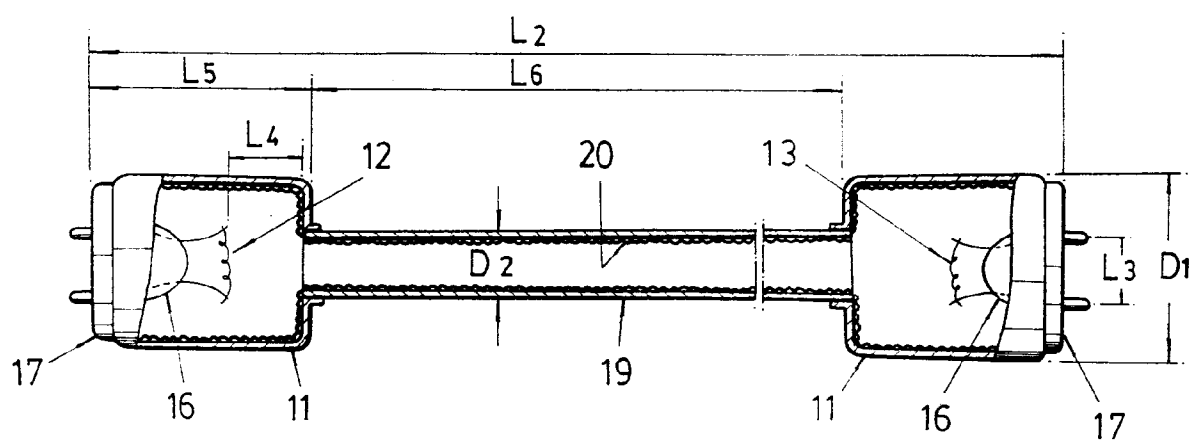


FIG 3

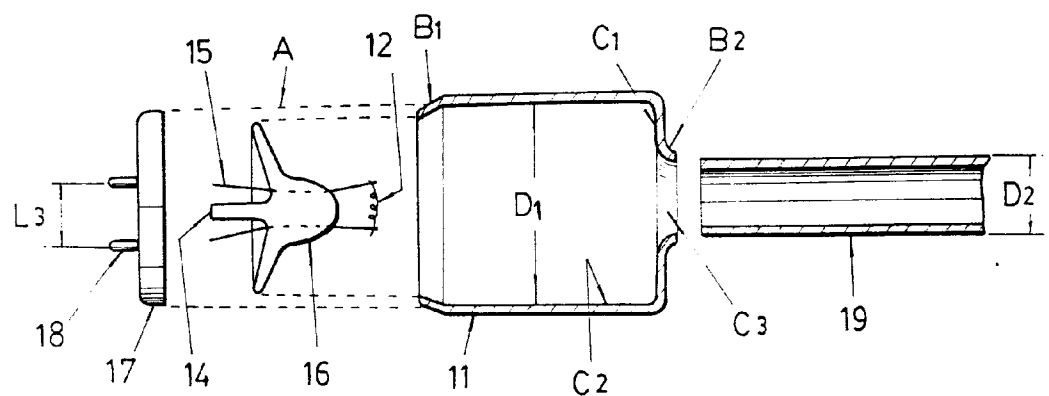


FIG 4

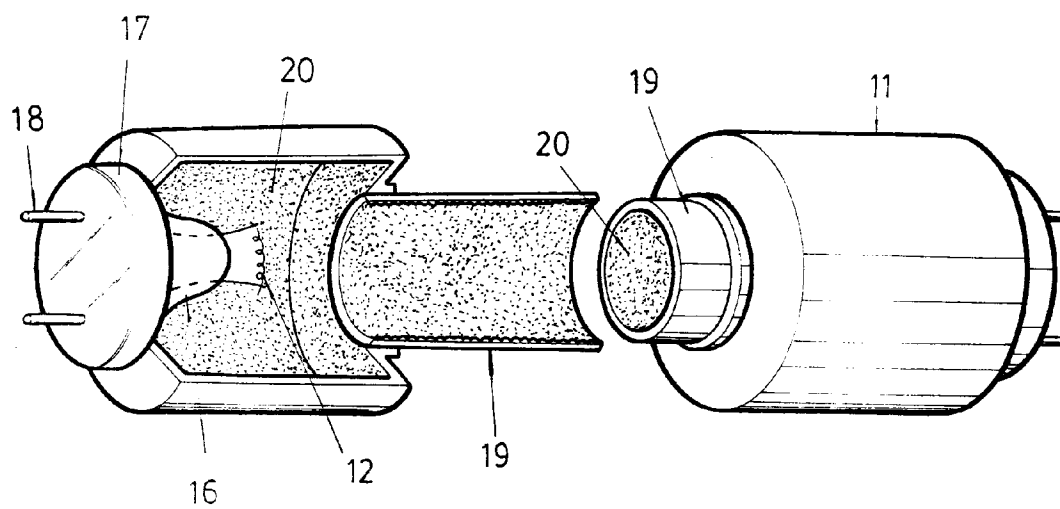


FIG 5 A

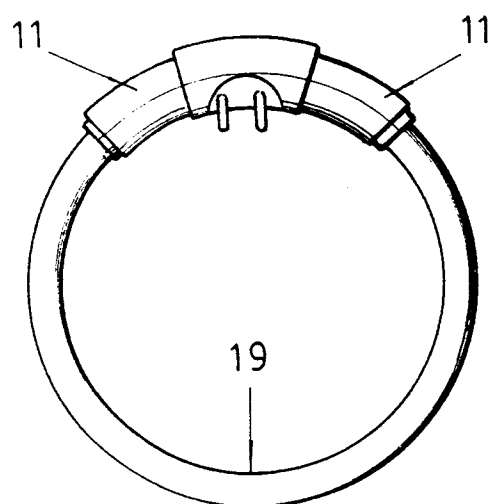
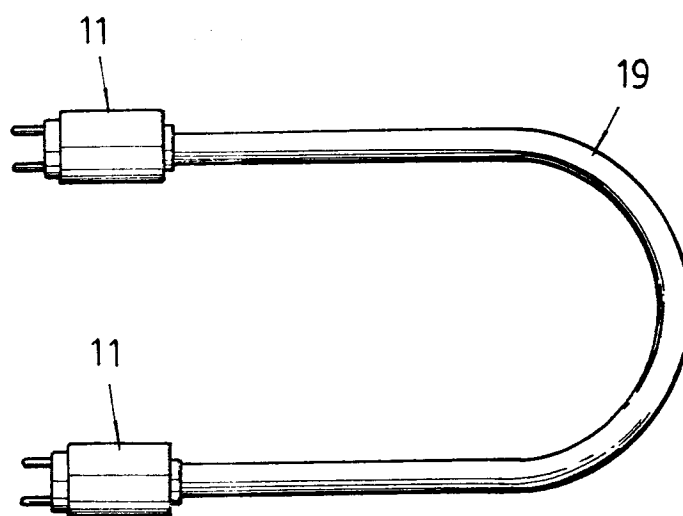


FIG 5 B





European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 93 30 4467

DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 04 OCTOBER 1993	Examiner ROWLES K.E.G.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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