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[54] **EXTRA HIGH OUTPUT AND HIGH OUTPUT
FLUORESCENT LAMPS**
6 Claims, 2 Drawing Figs.

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[51] Int. Cl..... H01j 61/44
[50] Field of Search..... 313/109

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ABSTRACT: An extra high output or high output fluorescent
lamp comprises first and second fluorescent layers superposed
on each other. The first fluorescent layer contains at least 10
percent by weight of manganese activated magnesium
fluorogermanate on the basis of the entire first layer. The
second fluorescent layer consists of calcium halophosphate
activated by antimony and manganese. The aforementioned
fluorescent lamp displays a reduced attenuation of luminous
fluxes relative to operating duration.

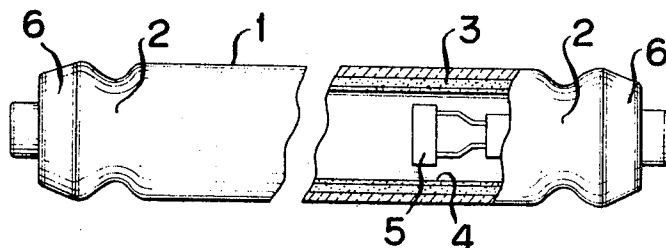


FIG. 1

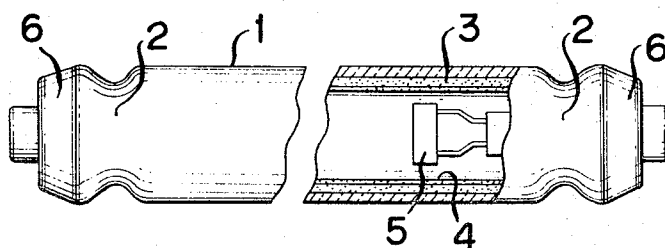
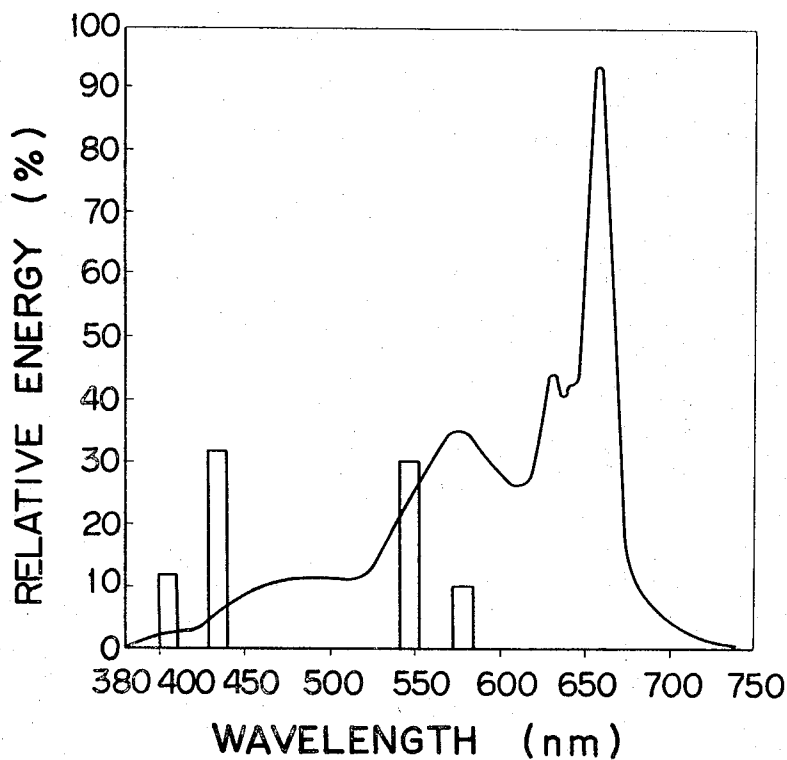


FIG. 2



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EXTRA HIGH OUTPUT AND HIGH OUTPUT FLUORESCENT LAMPS

The present invention relates to a fluorescent lamp and more particularly to extra high output and high output type fluorescent lamps of good color rendition which have been prominently improved in performance.

For improvement of the color rendition of a fluorescent lamp, it has been general practice to mix several kinds of fluorescent substances such as magnesium tungstate, calcium tungstate, manganese activated zinc silicate, tin activated calcium-strontium orthophosphate, tin activated strontium-magnesium-barium orthophosphate and manganese activated magnesium arsenate, and to coat said mixture on the inner wall surface of the glass tube to form a fluorescent layer thereby to make uniform the spectral energy distribution of said lamp over the entire visible region.

However, the aforesaid fluorescent layer had the drawback that when it is applied in an extra high output or high output-type fluorescent lamp which receives large inputs per unit length of the glass tube it causes the luminous flux of the lamp to be noticeably decreased while it was lighted. Further, when the layer is used in the aforementioned types of fluorescent lamps, outputs of the continuous spectral portion sharply drop as compared with those of the visible spectral lines of mercury as exhibited by the lamp in operation, with the resultant wide variations in the color temperature thereof. (This failure is aggravated, because outputs having a wavelength of 436 nm. involved in the spectral lines of mercury are extremely large.) There are further shortcomings, for example, that the tube wall of such fluorescent lamps rises in temperature to as high as 80° to 200° C., resulting in the reduced brightness of the fluorescent layer.

To eliminate the above-mentioned drawbacks, it may be contemplated to use a fluorescent material stable to heat and ultraviolet rays, suppress outputs of the spectral lines of mercury, particularly those having a wavelength of 436 nm. or improve the quality of gases to be sealed in the glass tube so as to improve the performance of the lamp.

The object of the present invention is to provide an extra high output and high output type fluorescent lamps of good color rendition which are prominently improved in performance.

According to the present invention, an extra high output and high output type fluorescent lamps comprise first and second layers of fluorescent lamps comprise first and second layers of fluorescent material. The first layer contains at least 10 percent by weight of manganese activated magnesium fluorogermanate, a fluorescent material most stable to heat. The second layer deposited on the first layer consists of calcium halophosphate activated by antimony and manganese. Such type of fluorescent lamp is improved prominently in performance and appreciably in color rendition.

According to the present invention, there is provided a fluorescent lamp comprising a light transmissible sealed envelope, coil electrodes sealed to both ends of said envelope, a quantity of mercury and an ionizable inert gas sealed in said envelope, and a fluorescent layer member deposited on the inner wall surface of said envelope and having a nominal rated lamp current of 0.8 to 1.5 amperes, said fluorescent layer member comprising a first fluorescent layer consisting of manganese activated magnesium fluorogermanate, deposited on the inner wall surface of said tube and having a thickness of 5 to 30 microns and a second fluorescent layer consisting of calcium halophosphate activated by antimony and manganese, deposited on said first fluorescent layer and having a thickness of 5 to 20 microns.

The present invention can be more fully understood from the following detailed description when taken in connection with the accompanying drawing, in which:

FIG. 1 illustrates an extra high output fluorescent lamp according to an embodiment of the present invention with part broken away and shown in section; and

FIG. 2 is a curve diagram showing the spectral distribution of the output of the extra high output-type fluorescent lamp shown in FIG. 1.

There will now be described by reference to the accompanying drawing the preferred examples of the present invention which follow. It will be understood, however, that they are offered only by way of illustration and are not intended to restrict the scope and breadth of the invention or to limit the scope of the patent claims attached hereto.

EXAMPLE 1

There was deposited by the known method a paint consisting of manganese-activated magnesium fluorogermanate on the inner wall surface of a light transmissible sealed envelope 1 having an external diameter of 38 mm. and a length of about 1200 mm. and provided with neck constricted portions 2 at both ends, thereby to form a first layer 3 of fluorescent material 20 microns thick. On said layer 3 was applied by the known method a paint consisting of calcium halophosphate activated by antimony and manganese to form a second layer 4 of fluorescent material 10 microns thick. To both ends 63 of the envelope 1, on the inner wall surface of which were deposited the aforesaid fluorescent layers 3 and 4, were sealed coil electrodes including platelike auxiliary electrodes 5 and adhered recessed double contact bases 6 each having a pair of contacts. After the envelope was evacuated, a quantity of mercury and a gas mixture consisting of 5 percent He, 38 percent Ne, and 57 percent Ar, all percentages being by volume, was sealed in said envelope so as to be used as the ionizable inert gas. Thus was prepared an extra high output-type fluorescent lamp operable at the nominal rated wattage of 110 w. and nominal rated lamp current of 1.5 amperes.

Comparison of the properties of said extra high output lamp and those of the conventional similar lamp is given in the table below.

TABLE 1

	Initial Luminous Flux, lm.	Ra ¹	Percentage ²	Percentage ³
Conventional Lamp.....	4,600	77	55	30
Lamp of Example 1.....	4,600	79	76	60

¹ Ra denotes the general colour rendering index by a test colour method as specified by the Commission Internationale de l'Eclairage (C.I.E.).

² Preservation of Luminous Flux at 1,000 Hour Operation.

³ Preservation of Luminous Flux at 3,000 Hour Operation.

As clearly seen from the above table 1, an extra high output fluorescent lamp according to the present invention presented good color rendition and prominently improved performance. In other words, The present fluorescent lamp suffered less reduction in the luminous flux while it was used, proving usable for a long period under good conditions.

FIG. 2 shows the distribution of spectral energies of the aforementioned 110 w. extra high output-type fluorescent lamp. The abscissa represents wavelengths in nm. and the ordinate relative energies in percentage. The rectangular blocks in the FIG. represent output light beams having wavelengths of 405, 436, 546, and 758 nm. corresponding to the spectral lines of mercury. As apparent from the FIG., the present fluorescent lamp provides a good projection of light beams particularly having a wavelength of 655 nm. (a deep red color) and excellent color rendition. Further, since the spectral line of mercury having a wavelength of 436 nm. is controlled to a low level, the lamp exhibits less variations in the color temperature.

EXAMPLE 2

On the inner surface wall of a glass envelope having the same dimensions as that of example 1, was deposited a mixture of fluorescent materials consisting of 70 percent by weight of manganese-activated magnesium fluorogermanate

and 30 percent of manganese-activated magnesium boroarsenate to form a first fluorescent layer 20 microns thick. On said layer was deposited calcium halophosphate activated by antimony and manganese to form a second fluorescent layer 10 microns thick.

Later in the same manner as in example 1, there was prepared an extra high output-type fluorescent lamp operable at the nominal rated wattage of 110 w. and nominal rated lamp current of 1.5 amperes. Comparison of the properties of said extra high output-type lamp with those of the conventional similar lamp gave almost the same results as in table 1. The distribution of output spectral energies was substantially the same as that shown in FIG. 2.

EXAMPLE 3

On the inner surface wall of a glass envelope having the same dimensions as that of example 1, was deposited a mixture of fluorescent materials consisting of 50 percent by weight of manganese-activated magnesium fluorogermanate, 30 percent by weight of manganese-activated magnesium boroarsenate and 20 percent by weight of manganese activated magnesium arsenate to form a first fluorescent layer 20 microns thick. On said layer was deposited calcium halophosphate activated by antimony and manganese to form a second fluorescent layer 10 microns thick.

Later in the same manner as in example 1, there was prepared an extra high output fluorescent lamp operable at the nominal rated wattage of 110 w. and nominal rated lamp current of 1.5 amperes. The properties of said extra high output lamp and the distribution of output spectral energies therein were almost the same as in example 1.

EXAMPLE 4

On the inner wall surface of a glass envelope 38 mm. in external diameter and about 2,400 mm. long (As is known, a high output-type fluorescent lamp does not have neck constricted portions.) was deposited a fluorescent material consisting of manganese-activated magnesium fluorogermanate to form a first fluorescent layer 20 microns thick.

On said layer was deposited calcium halophosphate activated by antimony and manganese to form a second fluorescent layer 10 microns thick. To both ends of the glass envelope, the inner wall surface of which was coated with these fluorescent layers, were sealed electrodes and adhered recessed double contact bases having a pair of contacts. After the glass tube was evacuated, there was sealed an ionizable inert gas only consisting of argon. Thus was prepared a high output-type fluorescent lamp operable at the nominal rated wattage of 110 w. and nominal rated lamp current of 0.8 ampere.

Comparison of the properties of said high output-type lamp and the conventional similar lamp is given in the table below.

TABLE 2

	Initial luminous Flux, lm.	Ra ¹	Percentage ²	Percentage ³
Conventional Lamp.....	6,000	79	80	70
Lamp of Example 4.....	6,000	81	89	82

¹ See Table 1.

² Preservation of Luminous Flux at 1,000 Hour Operation.

³ Preservation of Luminous Flux at 3,000 Hour Operation.

As seen from table 2 above, a high output fluorescent lamp according to the present invention is improved in both color rendition and performance like the aforementioned extra high output fluorescent lamp.

This high output lamp displays almost the same distribution of spectral energies as the extra high output-type lamp of example 1 (except that outputs corresponding to the resonance spectral lines of mercury are slightly lower).

EXAMPLE 5

On the inner wall surface of a glass envelope having the same dimensions as that of example 4, was deposited a mixture of fluorescent materials consisting of 80 percent by weight of manganese-activated magnesium fluorogermanate and 20 percent by weight of manganese-activated magnesium boroarsenate to form a first fluorescent layer 20 microns thick.

On said layer was deposited calcium halophosphate activated by antimony and manganese to form a second fluorescent layer 10 microns thick.

Later in the same manner as in example 4, there was prepared a high output-type fluorescent lamp operable at the nominal rated wattage of 110 w. and nominal rated lamp current of 0.8 ampere. This high output-type lamp exhibited almost the same properties and distribution of spectral energies as in example 4.

In the aforementioned five examples, the first fluorescent layer had a thickness of 20 microns and the second fluorescent layer 10 microns. However, experiments show that the thickness of the first layer is only required to fall within the range of 5 to 30 microns, the optimum value being 20 microns, and that the thickness of the second layer is only required to range between 5 and 20 microns, the optimum value being 10 microns. Thickness outside of the aforesaid ranges fail to achieve the desired effect.

In the aforesaid examples, the first fluorescent layer consisted of manganese-activated magnesium fluorogermanate alone, a mixture of manganese-activated magnesium fluorogermanate and manganese-activated magnesium boroarsenate or a mixture of manganese-activated magnesium fluorogermanate, manganese-activated magnesium boroarsenate and manganese-activated magnesium arsenate. The first fluorescent layer is not required to have the specified weight percentages. The only critical condition is that the weight percentage of the manganese-activated magnesium fluorogermanate be at least 10 percent on the basis of the composition of said layer. If the content of the aforementioned material is smaller than 10 percent on the basis of the composition of the first layer, the fluorescent layer member as a whole will be prominently reduced in luminescing efficiency, when the temperature of the lamp envelope wall approaches 100° C., and considerably degraded under the irradiation of ultraviolet rays. Insofar as the aforesaid critical condition is fully met, each of the above-listed mixtures constituting the first layer will have the same effect with respect to the properties of a fluorescent lamp as when said layer consists only of manganese-activated magnesium fluorogermanate.

In the foregoing examples, the weight percentages of antimony and manganese contained in the calcium halophosphate activated by antimony and manganese constituting the second fluorescent layer accounted for 0.8 percent and 1.0 percent respectively. A fluorescent lamp thus prepared has a color temperature of 3,100° K. when it is lighted and is best adapted for general lighting purposes as well as for joint use with a halogen lamp in illuminating a color television studio. However, the aforementioned weight percentages of antimony and manganese do not form the feature of the present invention, but as is known to those skilled in the art, said percentages may be changed to vary the color temperature of the lamp.

We claim:

1. In a fluorescent lamp having a nominal rated lamp current of 0.8 to 1.5 amperes, comprising a light transmissible sealed envelope, coil electrodes sealed to both ends of said envelope, a quantity of mercury and an ionizable inert gas sealed in said envelope, and a fluorescent layer member deposited on the inner wall surface of said envelope, the improvement wherein said fluorescent layer member comprises a first fluorescent layer comprised of manganese-activated magnesium fluorogermanate deposited on the inner wall surface of

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said envelope and having a thickness of 5 to 30 microns, and a second fluorescent layer comprised of calcium halophosphate activated by antimony and manganese deposited on said first fluorescent layer and having a thickness of 5 to 20 microns.

2. A fluorescent lamp according to claim 1 wherein said first fluorescent layer further contains at least one fluorescent material selected from the group consisting of manganese-activated magnesium boroarsenate and manganese-activated arsenate, the weight percentage of the manganese-activated magnesium fluorogermanate accounting for at least 10 percent.

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3. A fluorescent lamp according to claim 1 wherein said first fluorescent layer is 20 microns thick.

4. A fluorescent lamp according to claim 1 wherein said second fluorescent layer is 10 microns thick.

5. A fluorescent lamp according to claim 1, wherein said inert gas comprises a mixture of helium, neon and argon.

6. A fluorescent lamp according to claim 1 wherein said inert gas comprises a mixture of 5 percent helium, 38 percent neon, and 57 percent argon, said percentages being by volume.

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