United States Patent

Schreurs

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[54] POLYSPECTRAL FLUORESCENT LAMP

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[73] Assignee: **Sylvania Electric Products Inc.**

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[52] **U.S. Cl.**.....**313/109**, 313/111, 240/1

[51] **Int. Cl.**.....**H01j 61/20**, H01j 61/44

[58] **Field of Search**.....313/109, 110, 111, 113, 114, 313/115

[56] **References Cited**

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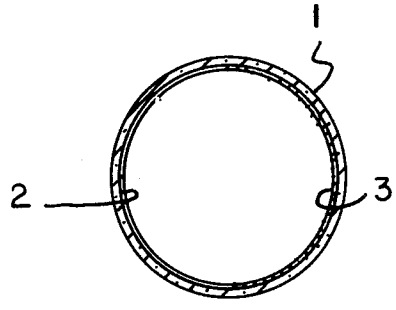
[57] **ABSTRACT**

The inner surface of a tubular fluorescent lamp has at least two separate and distinct phosphor coatings on different longitudinal segments thereof, the color of light emitted by each phosphor coating differing from that of the other. The lamp is rotatably mounted in a fixture having an aperture parallel to the lamp. By suitable rotation of the lamp within the fixture, light from either of the phosphors may be preferentially directed through the aperture for illumination purposes.

3 Claims, 2 Drawing Figures



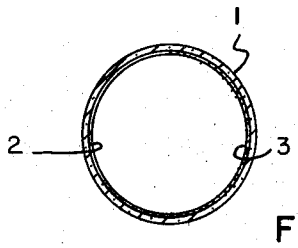


FIG. 1

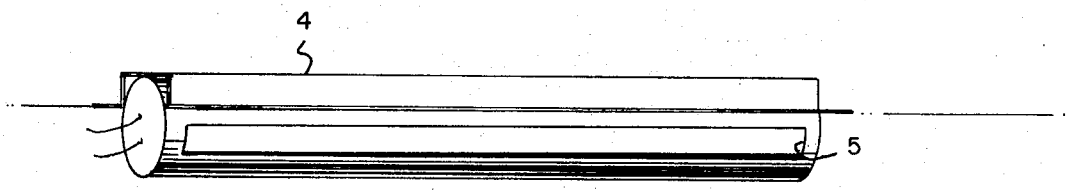


FIG. 2

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POLYSPECTRAL FLUORESCENT LAMP

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to fluorescent lamps and particularly to such lamps having different phosphors on longitudinal segments thereof capable of emitting light of different colors.

2. Description of the Prior Art

For some lighting purposes it is desirable to employ a lamp that is capable of supplying illumination the color of which can be varied. For example, such a lamp may be used to observe the appearance of textiles which have been dyed, say, for use in manufacturing a suit or dress, under illumination that corresponds to natural daylight or incandescent light or a particular type of fluorescent light. Such a material may be pleasing to the eye when viewed in daylight, but may be dull and unattractive when viewed under incandescent light. The reason for this is that incandescent light is deficient in colors found at the short wavelength end of the color spectrum, that is, the blues, violets and greens, and material predominating in such colors is dulled when viewed under incandescent light. Thus, it would be desirable to observe dyed cloth under all lighting conditions in which it could be used in order to determine that its visual appearance would be satisfactory.

Another use of variable color illumination is in cosmetics application, where the color of such cosmetics should be pleasing whether veiwed under natural daylight conditions or under incandescent or fluorescent light.

In the past, commercially available lamps for such applications were often used in fixtures in which different colored filters could be interposed between the lamp and the subject to be illuminated. Such an arrangement was not always entirely satisfactory, since such filters substantially reduced the total illumination falling on the subject. In addition, a single light source could not usually supply sufficient spectral energy of the necessary wavelengths to satisfactorily match the color of different types of illumination.

The use of separate light sources to provide each type of desired illumination resulted in apparatus that was generally awkward and space consuming.

It is the purpose of this invention to provide a single fluorescent lamp that is capable of supplying light of either of at least two different colors.

SUMMARY OF THE INVENTION

A fluorescent lamp in accordance with this invention has at least two separate phosphor coatings on the inner surface of a tubular lamp envelope and on different longitudinal segments thereof. The color of light emitted by each phosphor differs from that of the other and can be designed to closely match the color of a predetermined type of illumination. For example, one of the phosphors can be compounded to emit light of a color that closely matches that of incandescent light; the other phosphor can be of a type that emits light of a color that matches natural daylight.

In operation such a lamp is disposed inside an enclosing fixture which has a narrow aperture along one surface thereof. The aperture is proximate the lamp and is substantially parallel thereto so that most of the light passing through the aperture emanates from the phosphor coating that faces the aperture. The lamp is rotatably mounted within the fixture so that either phosphor coating may be presented to the aperture depending on the type of illumination desired. Suitable electrical connecting means are disposed in the fixture for the purpose of connecting the lamp to an external source of electrical power.

In order that the desired illumination emanate substantially only from the proximate phosphor coating, the width of the aperture is kept small and preferably does not substantially exceed the width of the chord subtended by the arc of the proximate phosphor coating. For example, if a lamp has two phosphor coatings, each covering 180° of the lamp circumference the width of the aperture should not substantially exceed the lamp diameter. And if a lamp has three phosphor coatings of 120° coverage each, the aperture should not exceed about 86 percent of the lamp diameter; for four 90° coatings, the maximum aperture width would be about 70 percent of the lamp diameter. Of course the width of the aperture should not be so narrow that only an undesirably small fraction of the total light output of the lamp can pass therethrough and fall on the subject desired to be illuminated.

Preferably, the inside surface of the fixture is substantially non-reflective in order to prevent any significant amount of light emitted by the distant phosphor coating from being reflected by the fixture and passing out through the aperture. However if the lamp diameter exceeds about 50 percent of the inside diameter of the fixture, where the fixture is substantially circular, then the lamp itself will block most of the reflected light from passing out through the aperture.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross sectional view of a fluorescent lamp having two different phosphor coatings on the inner surface of the lamp envelope.

FIG. 2 is an illustrative drawing of such a lamp within an apertured fixture.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In a specific embodiment of a fluorescent lamp in accordance with this invention, as shown in FIG. 1, a tubular glass envelope 1 has phosphor coatings 2 and 3 longitudinally disposed on the inner surface thereof. Each coating covers about 180° of the lamp circumference. One phosphor coating, say, phosphor 2, is of a type that emits light the color of which closely resembles the color of light from an incandescent lamp. The other phosphor coating, phosphor 3, emits light of a color that closely resembles the color of average natural daylight.

Phosphor coating 2 is deposited on glass envelope 1 from a suspension containing a blend of the following material:

	Wt. %
Barium-strontium-magnesium orthophosphate, tin activated	66 %
Magnesium fluorogermanate, manganese activated	15 %
Calcium halophosphate, antimony-manganese activated	2.5 %
Barium-titanium pyrophosphate	12 %
Strontium pyrophosphate, tin activated	1 %
Zinc orthosilicate, manganese activated	1 %
Yellow titanium oxide	2.5 %

The blend has a mean particle diameter of 10 microns and is dispersed in a vehicle consisting of nitrocellulose binder in butyl acetate solvent.

Glass envelope 1 is washed, prior to coating, and then allowed to dry. A sufficient amount of the suspension is then poured into envelope 1, envelop 1 being tilted slightly above a horizontal position, to form a pool of suspension in the bottom of the envelope when envelope 1 is placed in a horizontal position. Envelope 1 is then slowly rotated until about 180° of its surface is coated by the suspension. The excess suspension is then poured off and the coating allowed to dry with the envelope in a vertical position.

Phosphor coating 3 is deposited on the remaining 180° surface of envelope 1 in a similar manner as coating 2 from a suspension containing a blend of the following materials:

	Wt. %
Calcium-strontium-magnesium orthophosphate, tin activated	35 %
Barium-titanium pyrophosphate	47 %
Calcium-magnesium tungstate, lead activated	15 %
Zinc orthosilicate, manganese activated	3 %

This blend is dispersed in a vehicle consisting of ethyl cellulose binder in xylol solvent, xylol being used as the solvent since it will not dissolve the nitrocellulose binder of coating 2 at the point where coating 3 contacts, but does not overlap, coating 2. After the second phosphor has been allowed to dry, the coated envelope is heated for three minutes at 600°C. to burn off the binder and to cause the phosphor particles to adhere to the surface of the envelope.

The lamp is then completed by conventional methods including the steps of disposing electrodes and bases at each end of the envelope, exhausting the envelope, filling with an arc-sustaining filling including mercury and then sealing.

In operation the phosphors transform the radiation from the mercury arc into visible radiation. Phosphor coating 2 emits light of a color that closely resembles the color of light from an incandescent lamp. The purpose of the yellow titanium oxide, a non-phosphor material, in coating 2 is to filter the high peaks of violet and blue light emitted by the mercury arc and thereby improve the resemblance to incandescent light. Phosphor coating 2 has a Color Rendering Index of 94.0 percent at a color temperature standard of 2,700°K.

Phosphor coating 3 emits light of a color that closely matches the color of average natural daylight. It has a Color Rendering Index of 89 percent at a color temperature standard of 6,750°K.

In operation the lamp is axially mounted inside an elongated tubular fixture 4, as illustrated in FIG. 2, having about double the diameter of the lamp. An aperture 5 having a width about half the lamp diameter extends along the length of the fixture parallel to the lamp. The lamp is rotatably mounted within the fixture so that either phosphor coating 2 or 3 may be presented to the aperture depending on whether incandescent type illumination or average natural daylight illumination is desired. Thus by means of this single lamp, an object may be viewed under either daylight or incandescent light.

If it is desired to introduce a third color into the light emission of the lamp, then phosphor coatings 2 and 3 can each be reduced to 120° coverage, and a third phosphor coating can be deposited on the remaining 120° lamp surface. Such a third phosphor can comprise a phosphor used in particular types of commercially available fluorescent lamps, such as White, Cool White, Natural White and the like.

Before deposition of the third phosphor coating, the first two coatings would preferably be baked at the previously mentioned heating conditions, to render them resistant to the solvent in the third phosphor coating.

It is not necessary, for pruposes of this invention, that the phosphor coatings be designed to emit light of a color which closely matches that of other natural or artificial lumination. A lamp capable of emitting light of either to two or three or more colors may be desired for the purpose of illuminating a painting or other art object and for varying from time to time the color of the illuminating light and thus the artistic effect of the object.

For example, the phosphor of coating 2 an emitter of incandescent type light, may be one of the coatings deposited on the lamp surface. A second phosphor coating prepared to emit red colored light, can consist of the red-emitting components of phosphor coating 2, namely, the tin-activated barium-strontium-magnesium orthophosphate and the manganese-activated magnesium fluorogermanate. And a third phosphor coating designed to emit blue colored light, can consist of the blue-emitting components of phosphor coating 2, namely, the titanium pyrophosphate and the tin-activated strontium pyrophosphate.

In a lamp having these three phosphor coatings, the color of light available for illumination through the fixture aperture can be varied considerably by presenting different ratios of adjoining phosphor coatings to the aperture. In addition, brightness control could be obtained by depositing a reflector-type coating, such as is shown in U.S. Pat. No. 3,225,241 entitled "Aperture Fluorescent Lamp" issued to Spencer et al. on Dec. 21, 1965, between parts of the phosphor coatings and the lamp envelope. Lamp brightness could be decreased by increasing the amount of the reflector coating that is presented to the aperture.

Although the preferred embodiments of the polyspectral lamp of the instant invention are described for use within an apertured fixture, such lamps may also be used in an ordinary fluorescent fixture which is made non-reflecting or may even be used without a fixture. In the latter case suitable means would be used to energize the lamp and support it at its ends. The desired type of illumination would be obtained by positioning the lamp so that light from the corresponding phosphor coating would shine directly on the object to be illuminated. The other phosphor coating would radiate its light in the opposite direction.

I claim:

1. A fluorescent lamp comprising: an elongated glass envelope; electrodes disposed at either end of said envelope; an arc-sustaining filling disposed within said envelope; and at least two separate phosphor coatings disposed on the inner surface of said envelope, said phosphor coatings being disposed on separate longitudinal segments thereof and each phosphor coating designed to emit light of a different color than the other and wherein substantially the entire inner surface of said envelope is covered by said phosphor coatings, whereby illumination of at least two different colors may be obtained from said lamp by axial rotation thereof in relation to a region to be illuminated.

2. The lamp of claim 1 wherein one of said phosphor coatings is an emitter of incandescent type light and the other phosphor coating is an emitter of daylight type light.

3. The lamp of claim 1 comprising, in addition, an elongated fixture having an aperture, said lamp being rotatably mounted within said fixture and said aperture being substantially parallel to said lamp, the length of said aperture being about equal to the length of said lamp, the width of said aperture being less than the length of a chord subtending the arc of the phosphor coating having the greater circumferential coverage on said envelope.

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