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L. BURNS

2,774,903

NON-ACTINIC FLUORESCENT LAMP

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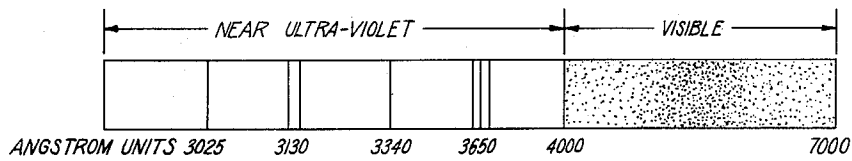


Fig. 1

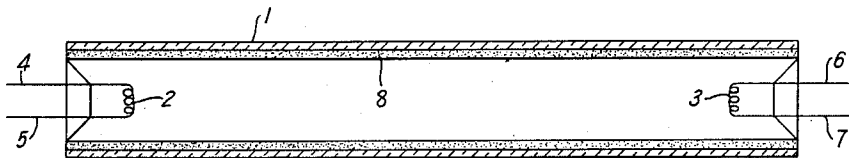


Fig. 2

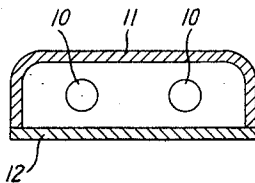


Fig. 3

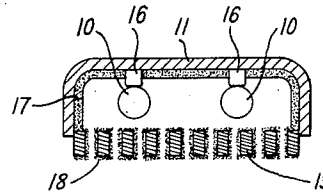


Fig. 4

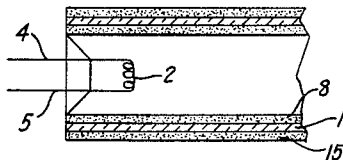


Fig. 5

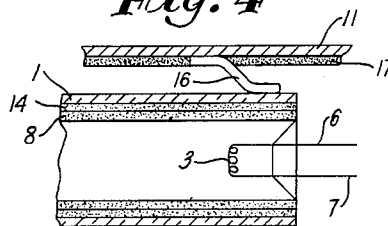


Fig. 6

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2,774,903

NON-ACTINIC FLUORESCENT LAMP

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Application January 17, 1951, Serial No. 206,440

10 Claims. (Cl. 313—109)

This invention relates to electric discharge lamps and particularly to fluorescent lamps.

An object of the invention is to reduce eye fatigue and the like from fluorescent lamps by eliminating or reducing the amount of ultra-violet light emitted by such lamps. A feature of the invention is a fluorescent lamp envelope which transmits visible but absorbs ultra-violet light and another feature is a coating for this same purpose. Other objects, advantages and features of the invention will be apparent from the following description taken in connection with the accompanying drawing in which:

Figure 1 is a representation of a spectrogram of an ordinary fluorescent lamp;

Figure 2 is a lamp according to the invention;

Figure 3 is a fixture according to the invention;

Figure 4 is another fixture according to the invention;

Figure 5 is a broken view in section, of a lamp according to a modification of the invention; and

Figure 6 is a broken view, in section, of a lamp according to further modification of the invention.

It has been found that fluorescent lamps often produce eye fatigue greater than that from incandescent lamps. This may be due to various factors, one of which is the ultraviolet emission from the lamps. The lamps ordinarily produce the mercury spectrum, which includes radiation, or "lines" as in Figure 1, at roughly 3650 Angstrom units, and also at 3340, 3130 and 3025. These radiations cause the eye itself to fluoresce, and by thus reducing the sharpness of vision under the light, cause eye strain. When the fluorescent materials used are a blend of magnesium tungstate and zinc manganese beryllium silicate, there is very little ultraviolet radiation from the fluorescent powders themselves, but the mercury radiations previously mentioned still are present. When calcium tungstate is used as one of the fluorescent materials, radiations just below the blue are produced and when calcium silicate, activated conjointly with manganese and lead is used, considerable radiation of about 3200 Angstrom units is produced. The latter phosphor produces a buff visible light but also some ultraviolet; it has two separated emission bands.

Figure 2 shows a glass envelope 1, containing an inert gas, for example, argon at a few millimeters pressure, and mercury vapor, and having an electrode 2, 3 sealed into each end by the lead-in wires 4, 5, 6, 7. A fluorescent coating 8 is on the inside of the envelope 1. The envelope 1 has heretofore been made of lead or lime glass which transmits ultraviolet in the region above 3000 Angstrom units to some extent, transmitting 3650 Angstroms very well.

According to my invention, the absorption of this glass for ultraviolet may be increased by use of additional iron, for example, ferrous oxide, in the glass or by use of an envelope of the glass now well-known as "Noviol," made by the Corning Glass Works, of Corning, N. Y. "Noviol O" is good.

If desired, the glass of the envelope 1 may remain un-

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changed, if an ultraviolet absorbing layer 14, 15 is used on the inside or outside of the glass. A fluorescent material emitting visible light in response to excitation by ultraviolet in the 3000 to 3800 Angstrom range may constitute this layer 14, 15. This would be in addition to the main fluorescent material which responds chiefly to radiations below 3000 Angstrom, such as the 2537 Angstrom mercury radiation. Such a material would be zinc vanadate or uranium-activated calcium fluoride or sodium fluoride, for example. These give a yellow or yellowish-green light, and the main fluorescent materials used would have to be such, or so blended, as to give a white light, or the desired color, in the presence of this additional light.

In some cases it may be more convenient to use an ultraviolet absorbing glass or plastic in the fixture, as shown schematically in cross-section in Figure 3, where the lamp 10 is surrounded by the reflector 11 and the light transmitting, ultraviolet absorbing piece 12.

In other cases, it may be desirable to use the louvers 13 as shown in Figure 4. These will shield the eyes from the direct light from the lamp or lamps 10 in the reflector 11, and may have a coating 18 of a substance which reflects visible light but absorbs ultraviolet. The fluorescent materials previously mentioned may be used for this purpose, being applied in a varnish, a lacquer, or a plastic. The louvers 13 may be, for example, as shown in application, Serial No. 481,040, filed March 29, 1943, now Patent 2,364,992 by Rene G. Maurette. When a blend of fluorescent powders including calcium silicate activated with both manganese and lead conjointly is used, it may be desirable to mix in with the blend a green or yellowish-green fluorescing material, responsive to the ultraviolet emitted by the calcium silicate. This will eliminate or reduce the amount of ultraviolet emitted by the coating—as well as that emitted by the mercury vapor—and will at the same time add some green light to that emitted by the calcium silicate. Since the spectrum of calcium silicate, even when supplemented by the spectrum of magnesium tungstate physically admixed with it, is generally slightly deficient in the green, this serves a double purpose.

The uranium-activated calcium fluorides and other materials of U. S. Patent 2,323,284, issued June 29, 1943, to W. P. Toorks may prove useful in this respect. Zinc vanadate may be useful if the yellow portion of the spectrum is to be enhanced.

The usual lead or lime glass used in fluorescent lamp bulbs decreases rapidly in transmission with wavelength, as the latter is reduced below 3300 Angstroms, so that the wavelengths above this value are the chief ones to be absorbed from the present lamps although some of the lower wavelengths down to 3000 Angstroms are transmitted to a lesser extent. When the fluorescent material used has high emission below 3300 Angstroms, considerable radiation below that wavelength may be emitted despite the low glass transmission of regular bulbs at that wavelength.

Where an absorbing layer 14, 15 is used in the lamp, it should be ordinarily placed between the regular fluorescent layer 8 and the glass envelope 1, unless it is placed on the outside of the glass envelope, or unless it has high transmission for the 2500 Angstrom radiation which excites the main fluorescent material. In addition to the absorbing materials previously mentioned, zinc or titanium oxides will be found quite effective, zinc being especially effective against the 3650 Angstrom wavelengths and lower. Zinc oxide will also be found good as a material for the coating 17, 18 on reflector 11 and louvers 13, in Figure 2, for it does not reflect ultraviolet light but does reflect visible light. Titanium is also useful in this respect, but is not as effective in preventing

reflection as it is in preventing transmission. Lithopone is effective against transmission, but not against reflection.

Crookes glass, particularly that known as "Crookes A," reduces the 3650 radiation to a small percentage, and substantially eliminates those lower, in a thickness of 2 millimeters. It is thus very effective as a filter glass 12 in the fixture of Figure 2, and is also effective as the glass of the lamp envelope.

Where the glass transmission is reduced by addition of ferrous oxide to the batch from which it is made, 0.2 to 1% will generally be found sufficient. Titanium and cerium oxides have also been found effective for this purpose.

In Figures 3 and 4, the filter 12 and louvers 13 are shown in cross-section. They extend longitudinally with the tube 10.

A thin gold film on the glass envelope may sometimes be desirable as the filter 14, 15 which transmits visible and absorbs ultraviolet light. Such a film has the additional advantage that it allows starting of the lamp at lower voltage and makes its starting independent of the ambient humidity. In ordinary commercial fluorescent lamps as now sold, the necessary starting voltage rises with humidity.

This rise may also be reduced in a different manner without the gold coating, by providing spring metal pieces 16 electrically connected to and extending from the metal reflector 11 ordinarily used with the lamp 10, and bearing on the glass envelope 1 of the lamp 10 near the cathode 3. One may be used at each end of the lamp, but if the reflector 11 is, directly or indirectly, grounded to one end of the lamp, the spring piece bearing on the glass may be used at only the ungrounded end of the lamp 10. The spring piece 16 will ordinarily bear on the side of the lamp 10 nearest the reflector 11, to be out of sight and to facilitate insertion of the lamps in its sockets. This spring piece 16 may, of course, be used with the present commercial fluorescent lamps, which do not have ultraviolet absorbing means. And conversely, such a spring piece 16 is not at all necessary with my ultraviolet absorbing lamps unless a better starting condition is desired than is usual in present commercial lamps.

This application is in part a continuation of my co-pending applications Serial No. 568,737, filed December 18, 1944, now Patent 2,452,518 and Serial No. 50,608 filed September 22, 1948, now abandoned.

What I claim is:

1. A fluorescent lamp having air internal fluorescent coating and electric discharge emitting long-wavelength ultraviolet radiations and visible radiations and an outer envelope of ultraviolet-absorbing light-transmitting glass containing a substance which absorbs long wavelength ultraviolet radiations and selected from the group consisting of: zinc oxide, titanium oxide, cerium oxide, said glass being selected from the group consisting of lead glass and lime glass.

2. A fluorescent lamp having an internal electric discharge and fluorescent coating emitting long-wavelength ultraviolet radiations and visible radiations and an outer envelope of ultra-violet-absorbing light transmitting glass containing zinc oxide to absorb long wavelength ultraviolet radiations, said glass being selected from the group consisting of lead glass and lime glass.

3. A fluorescent lamp having an internal electric discharge and fluorescent coating emitting long-wavelength

ultraviolet radiations and visible radiations and an outer envelope of ultra-violet-absorbing light transmitting glass containing titanium oxide to absorb long wavelength ultraviolet radiations, said glass being selected from the group consisting of lead glass and lime glass.

4. A fluorescent lamp having an internal electric discharge and fluorescent coating emitting long-wavelength ultraviolet radiations and visible radiations and an outer envelope of ultra-violet-absorbing light transmitting glass containing cerium oxide to absorb long wavelength ultraviolet radiations, said glass being selected from the group consisting of lead glass and lime glass.

5. A fluorescent lamp having an internal fluorescent coating emitting ultraviolet and visible radiation and an envelope of light-transmitting glass containing on its inner surface a coating between the glass and the fluorescent coating, said second-mentioned coating comprising a substance selected from the group consisting of zinc oxide, titanium oxide, cerium oxide.

6. A fluorescent lamp having an internal fluorescent coating emitting ultraviolet and visible radiation and an envelope of light-transmitting glass containing on its inner surface a coating of titanium oxide between the glass and the fluorescent coating.

7. A fluorescent lamp having an internal fluorescent coating emitting ultraviolet and visible radiation and an envelope of light-transmitting glass containing on its inner surface a coating of zinc oxide between the glass and the fluorescent coating.

8. A fluorescent lamp comprising: a sealed glass envelope; a coating on the inside of said envelope and comprising a substance selected from the group consisting of zinc oxide, titanium oxide, cerium oxide; and a fluorescent coating over said oxide coating on the inside of said bulb.

9. A fluorescent lamp comprising: a sealed glass envelope; a coating of titanium oxide on the inside surface of said envelope; and a fluorescent coating over said oxide coating on the inside of said bulb.

10. A fluorescent lamp comprising: a sealed glass envelope; a coating of zinc oxide on the inside surface of said envelope; and a fluorescent coating over said oxide coating on the inside of said bulb.

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