

Dec. 30, 1947.

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2,433,404

LIGHT GENERATING DEVICE

Filed Feb. 25, 1942

FIG. 1.

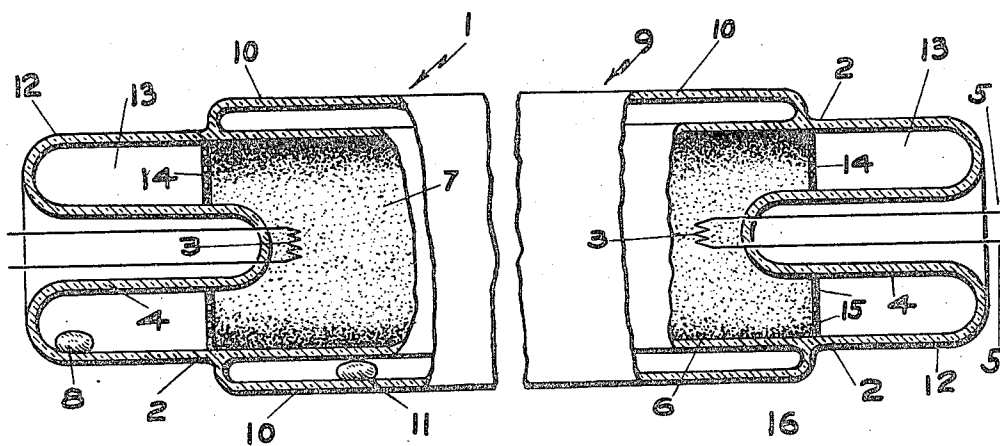
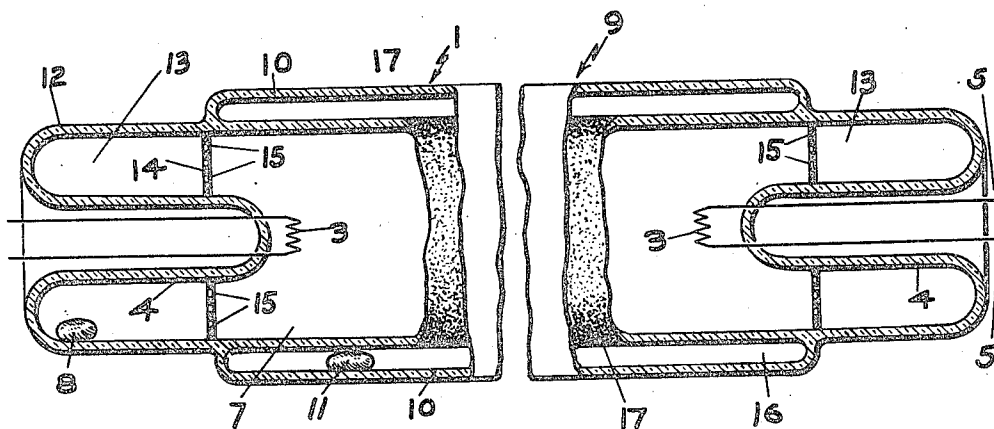


FIG. 2.



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2,433,404

LIGHT GENERATING DEVICE

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Application February 25, 1942, Serial No. 432,215

2 Claims. (Cl. 176-122)

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This invention relates to devices for generating radiations. More particularly this invention relates to light generating devices employing a medium, such as for example a fluorescent material, for translating light of certain wave lengths into light of other wave lengths.

Throughout this specification and the claims, the following terms are used in the sense herein-after indicated, except where the text indicates otherwise. The term "light" refers to light radiations both visible and invisible. The term "translating" in reference to light means changing light of one wave length to light of another wave length. A "fluorescent" material is a material which translates light. A "transparent" material is a material which transmits light without translation.

In light generating devices of the type referred to herein, light of one wave length may be translated by means of a suitable translating material into light of a desired wave length. For example, in mercury vapor lamps the ultra-violet light which is generated is translated by fluorescent material into visible light. In order to produce translation of most of the ultra-violet light generated, the fluorescent coating is preferably made of substantial thickness. However, the thicker the fluorescent coating is made the more opaque it will be to visible light and will thus absorb the visible light that is produced. If the fluorescent coating is made thinner, however, a substantial portion of the ultra-violet light generated will pass therethrough without translation and will thus be wasted. However this light might be used to advantage if it could be suitably controlled and directed.

Therefore it is an object of this invention to provide means for controlling and directing radiation emanating from a radiation-generating device.

A further object of this invention is the provision of a light generating device in which a greater portion of the light generated is translated with minimum absorption of the translated light.

Another object of this invention is the provision of an improved and more efficient light generating device of the type referred to herein.

Other and further objects and advantages of this invention will become apparent and the foregoing objects will be best understood from the following description of embodiments exemplifying said invention, reference being had to the accompanying drawing, in which

Fig. 1 is a cross-sectional view of a fluorescent

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lamp made in accordance with the present invention; and

Fig. 2 is a cross-sectional view of a modified form of a fluorescent lamp made in accordance with the present invention.

Referring now specifically to Fig. 1, the fluorescent lamp 1 has an envelope 2 provided with oppositely disposed electrodes 3 which as shown are of the coiled filament type and are preferably coated with an electron emitting material such as barium or strontium oxide, or the like, thereby giving a copious flow of electrons when heated. The electrodes may be made of tungsten or any other suitable material.

Lead-in and supporting conductors for the electrodes 3 extend through press stems 4 at opposite ends of the envelope 2 and are connected to contact terminals 5 provided at each end of the lamp.

A fluorescent coating 6 of any suitable material, such as the phosphors, is provided on the interior surface of the envelope 2 which is excited by the ultra-violet radiations generated during the discharge and which serves to translate the ultra-violet light into visible light, which visible light is transmitted through the walls of the envelope.

Prior to sealing off the lamp a suitable gas 7, such as argon, neon, or other noble monatomic gases, at several millimeters of pressure is introduced into the envelope together with an ionizable vapor such as that supplied by a small quantity of mercury 8.

The electrodes 3 are adapted to be heated by a suitable current and upon application of a suitable potential between said electrodes a discharge occurs therebetween. The discharge vaporizes the mercury within an extremely short period of time and causes the mercury to generate light in which the resonant lines of mercury which lie within the spectral range of about 2537 Angstrom units will predominate.

In this embodiment, in order to produce maximum radiation of the mercury resonance line of about 2537 Angstrom units wave length it is preferred that the temperature of the coolest portion of the lamp be such as to result in a mercury vapor pressure of the order of 1 to 20 microns, preferably about 10 microns, within the envelope. It is of course to be understood that this pressure may be varied within comparatively wide limits and that the lamp will still operate to generate light radiations.

The light generated within the lamp passes through the fluorescent coating. In this embodiment the fluorescent coating is preferably made

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thin enough to permit a substantial portion of the translated light, that is the visible light, to pass through said coating without absorption thereof. Furthermore in this embodiment at least a portion of the light generated within the lamp, especially the ultra-violet light, will pass through the fluorescent coating without translation. The portion of the envelope adjacent the coating or on which the coating is arranged is preferably thin enough and of a material to permit passage therethrough of a substantial portion of the untranslated light, especially at the 2537 Angstrom line, as well as the visible rays.

A jacket 9 including an outer wall 10 spaced from the wall of the envelope is preferably arranged surrounding the fluorescent coating. A globule of mercury 11 is inserted within the jacket and is adapted to be heated and vaporized by the heat from the envelope. The jacket 9 is closed to enclose this atmosphere of mercury. It is preferred that the temperature of the jacket be such that the mercury vapor pressure therein is of the order of 100 microns. Of course it is to be understood that this pressure can be varied substantially, as will be apparent hereinafter.

Ordinarily in a container the mercury vapor pressure is determined by the coolest portion of the interior surface thereof. As stated hereinbefore the mercury vapor pressure in the envelope is preferably of the order of 1 to 20, preferably 10, microns, while that in the jacket is considerably higher. Since both the interior of the envelope and the interior of the jacket are heated directly or indirectly by the energy of the discharge, they would tend to have approximately the same temperatures and same pressures. In order, therefore, to provide for a lower pressure in the envelope, a portion thereof may be cooled to a lower temperature to thereby produce a lower pressure. I prefer to accomplish this by providing oppositely-disposed extended ends 12 on the envelope. Being remote from the discharge area, these ends tend to be cooler. Furthermore, I prefer to isolate a region 13 within these ends 12 from the rest of the envelope by arranging a pair of relatively thin perforated washers 14 over the interior ends of the stems 4. Each of these washers is held in place by any suitable means. The washers 14 are preferably made of polished aluminum, and therefore reflect radiation from the discharge. The perforations 15 in the washers are sufficiently large to permit the vapor to pass freely therethrough without, however, allowing excessive radiation of energy through said perforations. These washers act as excellent heat shields. It will thus be seen that the region 13 will be cooler than the rest of the envelope, and thus produce a pressure less than the pressure within the jacket which is closer to, and not as well insulated from, the heat of the discharge.

If desired another gas 16, such as for instance helium, neon, and argon, may be inserted in the jacket. The gas selected must be one that does not quench the untranslated light, particularly the 2537 Angstrom line. This gas will serve to conduct heat from the wall of the envelope to the outer wall of the jacket.

The thickness of the atmosphere in the jacket is preferably such that it is of the order of ten times the mean free path of a photon of light in said atmosphere. If the pressure in the jacket is high enough and the jacket is thick enough most of the untranslated light passing through the fluorescent coating 6 will be reflected back to said coating until said light is translated thereby.

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The mercury atmosphere in the jacket is substantially transparent to the translated light passing from said coating.

It will thus be seen that by providing a thin coating which permits untranslated light, in this embodiment ultra-violet light, to pass therethrough without substantial absorption and by reflecting at least a portion of the untranslated light passing through said coating back to said coating, a more efficient lamp is provided. The untranslated light rays which pass through the coating are not wasted but by this means are reflected and then translated into light of the desired wave length.

According to my present understanding of the theory of operation of the atmosphere surrounding the fluorescent coating, photons of the untranslated wave lengths which pass through the coating are absorbed in said atmosphere. The amount of such absorption is dependent upon the pressure and thickness of the atmosphere. These absorbed photons are re-radiated in this embodiment as photons of the 2537 line. This re-radiation is a random one. Thus photons radiated by the atoms of said atmosphere back towards the fluorescent coating will impinge thereon and be translated by said coating. Other photons radiated in other directions will strike atoms of the atmosphere and will then be absorbed and radiated. Again those photons radiated in the direction of the fluorescent coating will impinge thereon and be translated while photons radiated in other directions will participate in subsequent collisions producing re-absorption and re-radiation. It will thus be seen that if the atmosphere is made of a sufficient thickness, that is of the order of several times the mean free path of a photon in that atmosphere, most of the photons of the 2537 line will be reflected back to the fluorescent coating and will be translated thereby. On the other hand, the reflecting atmosphere is substantially transparent to the translated light, such as for example visible light. The visible light will pass therethrough and will serve as a luminant.

A modified embodiment of the present invention is shown in Fig. 2. This embodiment is similar to that shown in Fig. 1, except that the fluorescent coating 6 is replaced by a fluorescent coating 17 which is arranged on the outside of the envelope 2 between the wall of the envelope and the outer wall 12 of the jacket. The fluorescent coating 17 is thereby shielded from the impact of the discharge and will have a longer operative life. It is of course understood that the material of which the envelope is made is such as to permit the passage therethrough of the light generated and especially of the 2537 line. Certain glasses are now well known in the art which permit the passage of ultra-violet light and of the 2537 line without complete absorption thereof. Of course it is well known that quartz will permit the passage of 2537 line therethrough and this material may also be employed.

While I have described a specific embodiment of my invention it is apparent that modifications may be made without departing from the teachings thereof. The constants set forth may be varied considerably; the form and arrangement of the lamp may be changed as will be apparent to any person skilled in the art. Various other means for providing different pressures of the gases or vapors within the envelope and its jacket will be apparent. These are but a few of the modifications that may be readily made by any

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one skilled in the art. It is accordingly desired that the appended claims be given a broad interpretation commensurate with the scope of the invention within the art.

What is claimed is:

1. A gaseous electric discharge lamp comprising an envelope, means for producing an electrical discharge in said envelope, mercury vapor at a relatively low pressure in the path of said discharge for generating light radiations under the influence thereof, means for translating at least some of said light radiations into light radiations of another wave length, said envelope and said translating means being at least partially transparent to said first-named light radiations, and an atmosphere of mercury vapor at a relatively high pressure surrounding said envelope for reflecting substantially all of the untranslated light radiations passing through said envelope and said translating means back to the translating means.

2. A gaseous electric discharge lamp comprising an envelope, means for producing an electrical discharge in said envelope, mercury vapor at a pressure of the order of one to twenty microns in the path of said discharge for generating invisible light radiations under the influence thereof, a fluorescent material disposed in the path of said invisible light radiations and adapted to translate at least a portion thereof into visible light radiations, said envelope and said

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fluorescent material being at least partially transparent to said invisible light radiations, and an atmosphere of mercury vapor at a pressure of about one hundred microns surrounding said envelope for reflecting substantially all of the invisible light radiations passing through said envelope and said fluorescent material back to said fluorescent material.

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