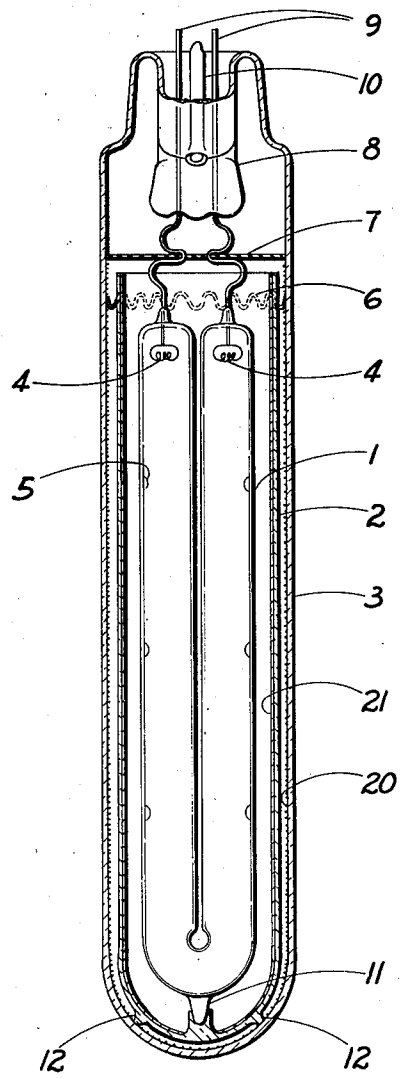
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GASEOUS ELECTRIC DISCHARGE LAMP DEVICE

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GASEOUS ELECTRIC DISCHARGE LAMP DEVICE

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The present invention relates to gaseous electric discharge lamp devices generally and more particularly the invention relates to such devices of the positive column arc or glow discharge type.

A discharge lamp is usually designed to radiate as much energy as possible in the visible region of the spectrum, so as to produce light from the input energy with high efficiency. In some cases, as in the high-pressure types of mercury lamp, a considerable amount of ultra-violet radiation is produced also under these conditions; it is possible to produce additional visible light from this radiation by using it to excite luminescent materials.

Alternatively it is possible to design a discharge lamp such as the low-pressure mercury lamp which emits much more ultra-violet radiation than visible radiation; and again by the use of luminescence to produce light with moderate efficiency.

The present invention relates to discharge lamps of the second type, i. e. an efficient source of ultra-violet radiation which may be used in combination with known luminescent materials to produce visible light, or may be utilized as ultra-violet radiation for medical or other purposes.

In a low-pressure, positive column, electric arc discharge, for example in the sodium lamp, the gas in the discharge tube is approximately at the temperature of the tube walls. Very little of the input energy is used in maintaining a temperature difference between the arc column and the tube; almost all of the input energy appears as heat required to maintain the tube at a temperature above that of the surroundings, energy for cathode heating, and as energy in useful radiation.

In order to reduce the amount of energy required to maintain the temperature of the tube, it is usual to surround the discharge tube itself with an evacuated bulb or a Dewar flask, or other form of heat insulation, which is made as efficient as possible, so that the percentage of the input energy available as radiation is increased.

In the case of the sodium lamp, the desired radiation is the resonance radiation of wave length 5890, 5896 Å. Since this must be able to leave the lamp, it is necessary to use Dewar flasks, or the like, with clear glass walls. It is known that the heat losses from such flasks are large compared with those from a flask whose walls are coated with a metal such as silver, copper or platinum, on the side adjacent to the vacuum space. While, if the heat losses are eliminated, almost all the input energy may be used in producing visible radiation; it appears that in practical sodium discharge lamps less than 20% of the input energy is radiated as visible light.

The object of the present invention is to provide a highly efficient ultra-violet generator comprising a low pressure discharge lamp in which improved heat insulation is effected by the use of a silvered Dewar flask, and to make use of the known "selective transmission" of silver films in the spectral region near 3200 Å. Another object of the invention is to provide an efficient lamp device which emits visible light from a luminescent material. Still further objects and advantages attaching to the device and to its use and operation will be apparent to those skilled in the art from the following particular description.

The invention attains the first of its objects by substituting for sodium in the above example a metal which is reasonably volatile, so that the operating temperature is not too high and has its resonance radiation in the spectral region where silver shows selective transmission. The resonance radiation will then be able to leave the lamp relatively freely, while the heat radiation will be efficiently retained by reflection from the silver.

Any metal or other substance whose presence in the electric discharge causes the emission of resonance radiation in the above spectral region would come within the scope of the invention. Two metals, however, appear to be particularly suitable, as having adequate volatility; these are cadmium and zinc. To compare the volatilities, we may compare their known boiling points with that of sodium. These are cadmium, 778° C.; zinc, 918° C.; sodium, 870° C. The wave lengths of the resonance radiations are known to be: cadmium, 3260 Å.; zinc, 3076 Å.

In making such a lamp it is necessary to make the discharge tube itself and the Dewar flask, of material transparent to these wave lengths. Various glasses such as that known under the registered trade-mark as "Corex D" are known to transmit 3260 Å. radiation freely; but the transmission of most glasses is much lower for such a short wavelength as 3076 Å. An alternative would of course be to use fused silica tubing; but the cost would be prohibitive. Both for this reason and because of the higher volatility and consequent lower operating temperature cadmium is to be preferred to zinc; but it is appreciated that the shorter wave-length radiation of zinc in a similar lamp might be of advantage in some uses, for example in medical applications,

such as "artificial sunlight" treatment where the most active radiations are those of wavelengths 3100 Å. to 2950 Å.

As the principle of the cadmium lamp is similar to that of a sodium lamp, in general any construction known to be suitable for sodium lamps may also be used for cadmium or zinc lamps, with the following modifications: All glass parts should be made of a glass transparent to radiation of 3260 Å. wavelength or 3076 Å. in the case of zinc. The discharge tube contains cadmium or zinc, in place of sodium, and the glass surface, especially those adjacent to the vacuum, are coated with films of silver of a suitable thickness.

In the drawing accompanying and forming part of this specification an embodiment of the invention is shown in a side elevational, partly sectional view.

The gaseous electric discharge lamp device illustrated in the drawing is a cadmium vapor lamp of the positive column discharge type and comprises an elongated U-shaped container 1 of vitreous material having a thermionic, activated electrode 4 sealed therein at each end thereof. Said electrodes 4 are provided with current leads 9 for connection with a source of electrical energy, preferably an alternating current source. Said container 1 has a starting gas therein, such as neon, at a pressure of about 1 to 10 mm. and a quantity of cadmium which, preferably, is distributed along the length of the container 1 as indicated at 5.

The container 1 is surrounded by a glass heat shield 2, and is supported therefrom by means of an upstanding support 11, the shield 2 being advantageously silvered on both sides. The container 1 and the shield 2 are mounted in a sealed bulb 3 which is exhausted to a high vacuum through the tube 10. Spacing members 12 and a support 6 of the type shown in the specification of British Letters Patent No. 434,720 serve to support the shield 2 in the bulb 3. The other glass surfaces 1 and 3 may also be silvered, but the container 1 will probably become too hot in operation for a silver film on it not to disintegrate in the course of time. The leads 9 to the lamp are sealed through the bulb 3 at the pinch 8. A mica disc 7 also serves to support the tube A. The mica disc 7 may advantageously also be silvered to assist in retaining the heat generated in the lamp. In the above description the word "glass" is understood to mean glass of a type capable of transmitting freely radiation of 3260 Å. wavelength.

Other constructions known to be suitable for sodium lamps are also suitable for a cadmium lamp; for example, a "cathodic" type of lamp could also be made with the same modifications.

Having produced a source of practically pure ultra-violet radiation of high efficiency as described above the second and principal object of the invention is attained by associating with such source a luminescent material, such as the Lenard phosphors, to convert this radiation to visible radiation of any desired continuous wavelength. The material employed will depend upon the use to which the lamp is to be put. It is known that the visibility of light depends upon its wavelength; thus light of wavelengths only between 5500 and 6000 Å. is more than twice as visible as white light of the same energy, white light having a uniform energy distribution over all wavelengths between 4000 and 7000 Å. If therefore the lamp is to be used purely for efficient illumination a luminescent material emitting light only in the yellow-green region of maximum visibility is to be used.

It is known however that if the colors of objects are to appear the same under the lamp as in ordinary daylight, the wavelength distribution of the light from the lamp must be the same as in daylight. A luminescent material or mixture of materials will therefore be employed which emits light of all wavelengths between 4000 and 7000 Å. in the desired proportions, in which case the efficiency in lumens per watt will be necessarily lowered.

It may be remarked that in order to show objects in their correct colors, it is an advantage to suppress any strong visible spectral lines from the discharge itself, since their presence prevents the imitation of the spectral distribution of daylight. This object is attained in the lamp described, as the silver films reflect and retain any visible radiation from the discharge almost equally with the infra-red heat radiation from the discharge tube.

A suitable construction in which luminescent material is included is that the inside of the bulb 3 is coated by known means with fluorescent powder or a mixture of such powders such as, for example, activated zinc sulphides. The method of operation is as follows:

The discharge in the lamp emits ultra-violet radiation and heat rays. The latter are retained by the silvered heat shield 2, but the ultra-violet radiation passes through and falls on the powder on the bulb 3. The powder emits visible light which passes through the glass bulb 3 (not silvered). The glass of bulb 3 is not required to pass ultra-violet radiation but only visible light, and any ordinary glass may accordingly be used for this.

This construction possesses the advantage that the fluorescent powder is exposed to the ultra-violet radiation in a vacuum. Certain gases cause the efficiency of the powder to diminish during long exposure to such radiation.

While I have shown and described and have pointed out in the annexed claims certain novel features of the invention, it will be understood that various omissions, substitutions and changes in the forms and details of the device illustrated and in its use and operation may be made by those skilled in the art without departing from the broad spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An electric discharge lamp device comprising an inner vitreous envelope having electrodes sealed therein and containing a volatile metal having its resonance radiation in the spectral region in which silver shows selective transmission, an outer evacuated vitreous envelope surrounding the inner one, a vitreous heat shield mounted within the outer envelope and surrounding the inner envelope, a silver coating on said heat shield and a coating of luminescent material on a surface in said outer envelope, said material being responsive to the radiation transmitted by said silver coating, said silver coating being interposed between the discharge path in said inner envelope and said luminescent coating.

2. An electric discharge lamp device comprising a vitreous envelope having electrodes sealed therein and containing a volatile metal having its resonance radiation in the spectral region in which silver shows selective transmission, a light

transmitting, heat retaining means supplemental to said envelope, a coating of silver and a coating of luminescent material on different surfaces of said lamp device, said luminescent material being responsive to the radiation transmitted by said silver coating, said silver coating being interposed between the discharge path in said envelope and said luminescent coating.

3. An electric discharge lamp device comprising a vitreous envelope having electrodes sealed therein and containing a quantity of cadmium, a light transmitting, heat retaining means supplemental to said envelope, a coating of silver and a coating of luminescent material on different surfaces of said lamp device, said luminescent material being responsive to the radiation transmitted by said silver coating, said silver coating being interposed between the discharge path in said envelope and said luminescent coating.

4. An electric discharge lamp device comprising a vitreous envelope having electrodes sealed therein and containing a quantity of zinc, a light transmitting, heat retaining means supplemental to said envelope, a coating of silver and a coating of luminescent material on different surfaces of said lamp device, said luminescent material being responsive to the radiation transmitted by said silver coating, said silver coating being interposed between the discharge path in said envelope and said luminescent coating.

CHRISTOPHER J. MILNER.