Sept. 18, 1956 W. T. ANDERSON, JR 2,763,806

VAPOR ELECTRIC DISCHARGE DEVICE

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Fig. 1.

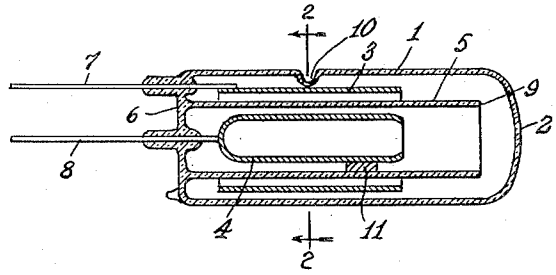
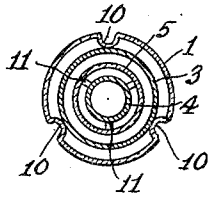


Fig. 2.



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VAPOR ELECTRIC DISCHARGE DEVICE

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4 Claims. (Cl. 313—185)

The present invention relates to vapor electric discharge devices and more particularly deals with a discharge device for providing a high intensity concentrated source for a resonance radiation of mercury.

The source for 2537 angstrom radiation is the mercury atom and when mercury atoms are present in low concentrations, i. e. low mercury vapor pressure of the order of about 0.01 millimeter, and when excited electrically, mostly resonance radiations at 2537 angstroms are emitted. Radiation at this wavelength in the short ultraviolet has bactericidal and photochemical properties, and because it can be produced in a nearly monochromatic form, has found widespread use in science and industry.

For certain applications it is desirable to obtain a highly concentrated or spot source of 2537 A. radiation suitable for projection by a lens system. The available lamps which are made in the form of straight or curved tubes or in spiral form, are inefficient when used with a lens system for the provision of a limited field of high intensity radiation at this wavelength because the discharge arcs are characterized by a substantially uniform intensity along the length of the discharge path, whereby the production of an efficient limited field of high intensity must take into consideration the length of the arc and is therefore, dependent upon particular adaptations of the lens system or of the envelope confining the discharge arc, in order to obtain full benefit of the radiation produced. Furthermore, the envelopes confining the discharge of the above type lamps are not easily adaptable for projection purposes, especially where it is desirable to insert the lamp through a limited opening of a vessel, e. g. for inspection of a bottle or other container with a limited entrance, since for efficient limited projected fields, without substantial loss of the radiations produced, at least a major portion of the arc length must be positioned for projection, and small insertable lamps of high intensity source of radiation would be difficult to manufacture without a substantial decrease of the desired radiation output.

According to the present invention, the above disadvantages are overcome by a lamp which provides a concentrated or spot source of mercury resonance radiation at 2537 angstroms. It is apparent that a spot source lamp made small enough for inserting purposes would be desirable since the desired radiation would be obtained from the concentrated spot source without substantial loss of any of the desired radiation produced and lamp dimensions could, therefore, be considerably reduced if necessary since the length of the arc in such lamp is of no critical consequence.

The primary difficulty in the production of resonance radiations at 2537 angstroms by excited mercury atoms is that the concentration of mercury atoms must be kept low, since there is a practical limit of the intensity of resonance radiation obtainable per unit volume. An increase in electric power with attendent increase in kinetic energy of the mercury atoms, or an increase in their concentration by further evaporation of liquid mercury, results in a decrease in resonance radiation when

the temperature of the mercury vapor is substantially raised or, e. g., exceeds about 50° C. (323° Kelvin). The increased energy is radiated at wavelengths other than the wanted resonance radiation, thereby producing a substantially non-monochromatic form of radiation with the resonance radiation present at less intensity since the temperature of the mercury vapor is raised and, in accordance with Boyle's law, the pressure is increased. This results in the absorption of a large part of the resonance radiation and the output includes substantial radiation of energy other than the resonance radiation.

It is an object of the present invention to provide a vapor electric discharge device for improved emission of the resonance radiation of mercury at 2537 angstroms. It is another object of the present invention to provide a concentrated source of a resonance radiation of mercury. It is a further object of the present invention to provide a lamp structure for obtaining a concentrated vapor discharge area suitable for projection of a wanted radiation by a lens system. It is a still further object of the present invention to provide a lamp structure for obtaining a spot source of a resonance radiation of mercury for the production of a limited field of high intensity radiation. Other objects and advantages of the present invention will become apparent from the description hereinafter following and the drawing forming part hereof in which:

Figure 1 is a longitudinal sectional view of a discharge device according to the present invention, and

Figure 2 is a cross-sectional view along lines 2—2 of Figure 1.

The present invention deals with a low pressure mercury vapor discharge device the structure of which is a departure from ordinary vapor arc lamps in that the main source of a wanted radiation, e. g. 2537 angstrom radiation, is a concentrated portion of the discharge arc so positioned with respect to a lamp envelope that it is especially suitable for the projection of the wanted radiation, e. g. for projection by means of a lens system to provide a limited field of high intensity.

According to Figure 1, the lamp envelope 1 is composed of a glass material, preferably fused quartz, in the form of a tube having a substantially convex end portion 2, said end portion having a wall thickness not exceeding about 0.030 inch and being highly transparent to ultra violet at wavelength 2537 angstroms.

The envelope 1 contains an amount of mercury sufficient when vaporized to provide a vapor pressure of about 0.01 millimeter at a temperature of about 323° Kelvin, and at least one of the gases argon and neon at a pressure up to about 20 millimeters. For example, the ionizable atmosphere may comprise mercury vapor at 0.01 millimeter pressure at 323° Kelvin together with 6 mm. neon and 2 mm. argon, or with argon at pressures between 3 and 20 millimeters.

The envelope 1 also contains a concentric arrangement of at least a pair of spaced electrodes 3 and 4, e. g. at least one outer electrode 3 and at least one inner electrode 4, having concentrically arranged between them an electrically non-conductive tube 5 of, for example, fused quartz, glass or the like material, and being welded or otherwise secured preferably to an end 6 of the envelope 1 axially opposite the end 2 of said envelope. The electrodes 3 and 4 are connected to lead-in conductors 7 and 8 respectively which are hermetically sealed through said envelope at the end 6 thereof. In accordance with the present invention the outer electrode 3 and the glass tube 5 are necessarily tubular, but the inner electrode 4 may be either tubular or a concentrated mass so long as concentricity of the arrangement is maintained substantially as illustrated by Figure 2, and it is desirable that the degree of concentricity to be maintained within about ten percent. Concentricity, as herein referred to, includes the

lamp envelope 1 since the envelope must have a shape substantially corresponding to that of the outer electrode 3. For example, if the tubular members inside the envelope are of elliptical cross section, then the envelope 1 is, likewise, of elliptical cross section in order to avoid such irregularity of spacing between the outer electrode and the wall of the envelope as would cause a concentration of the discharge arc at other than the wanted position.

The non-conductive tube 5 surrounding the electrode 4 is of a length such that it extends into the arc chamber beyond the ends of the electrodes 3 and 4 and the end 9 of this non-conductive tube is spaced from the inner wall of the envelope 2 at a distance greater than the distance between the outer side surface of the tube 5 and the inner surface of the concentric envelope 1 in order to provide a concentration of the discharge arc between the end 9 and the inner wall of the end 2. It will be apparent that in this manner a spot source of 2537 angstrom radiation is provided for emission through the end 2 of the envelope 1 which is desirably applicable for projection by a lens system, wherein a high intensity of 2537 angstrom radiation is possible in small lamps for providing a limited field of projected radiation.

The tubular members may be maintained in concentric position by supplementary means, for example, such as a constriction 10 in the envelope 1 or spacers 11 such as illustrated between the electrode 4 and tube 5 and as shown in Figure 2 in order to avoid a strain on the hermetic seals.

Although the input energy to the above described lamp is preferably limited by the necessity that the vapor temperature does not exceed about 323° Kelvin (50° C.), such input energy may be increased without a decrease of 2537 angstrom radiation by maintaining the stated temperature by the utilization of a cooling means associated with the envelope 2, or other appropriate discharge device component, according to known practices in the art for cooling discharge devices.

A small lamp of the above type may be operated at, for example, about 12.5 watts on a current limiting power supply, such as a reactive transformer. If cold cathode type electrodes are used, the voltage drop across the lead-in conductors are of the order of 120 volts at a current of about 0.140 ampere. If hot cathodes are used, the voltage drop is about 18 volts and the current about 0.9 ampere. These are alternating current operations and since current and voltage are not in phase, their products do not equal watts but may be considered as volt-ampere ratings.

What I claim is:

1. A vapor electric discharge device comprising a hermetically sealed tubular fused quartz envelope having a substantially convex end portion, said end portion being highly transparent to ultraviolet radiation at wavelength 2537 angstroms, said envelope containing sufficient mercury when vaporized to provide a vapor pressure of about 0.01 millimeters at about 323° Kelvin and at least one of the gases argon and neon at a pressure up to about 20 millimeters, said envelope containing axially and concentrically therewith a substantially concentric arrangement of an outer tubular electrode, an inner electrode and between said electrodes an insulating tube closed at one end and having an open end extending toward said convex end portion beyond said electrodes, the spacing between the end of said insulating tube and the inner surface of said convex end portion being greater than the spacing between the said insulating tube and the inner surface of said tubular envelope, said electrodes being connected to lead-in conductors hermetically sealed through an end of said envelope axially opposite the said convex end.

2. A vapor electric discharge device according to claim 1 wherein said inner electrode is a tubular electrode.

3. A vapor electric discharge device according to claim 1 wherein said electrodes are of the cold cathode type.

4. A vapor electric discharge device according to claim 1 wherein the said electrodes are of the hot cathode type.

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