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ELECTRICAL DISCHARGE DEVICE

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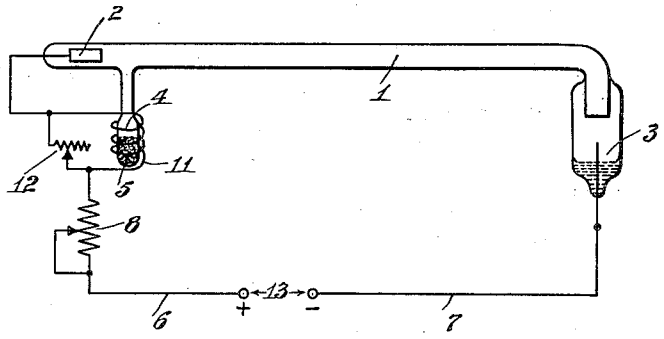

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UNITED STATES PATENT OFFICE

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ELECTRICAL DISCHARGE DEVICE

Application filed October 23, 1930. Serial No. 490,647.

This application is a continuation in part of my copending application Serial No. 343,873, filed March 2, 1929.

The invention relates to electrical discharge devices, particularly to devices used for purposes of illumination.

It is an object of the present invention to provide an electrical discharge tube which is capable of producing a very efficient white light.

Another object is to provide an electrical discharge illuminating tube wherein the color characteristics of the emitted light may be readily modified in a predetermined manner or be maintained constant at any desired value.

A further object is the provision of an electrical discharge tube operating at high efficiency and adapted to produce a concentrated brilliant light emission approximating sunlight.

In accordance with my invention a radiant energy emitting discharge device is constructed having a filling of gas at reduced pressure and a plurality of electrodes for conducting an electrical discharge therethrough. For modifying the light emission from the device auxiliary means are arranged to add to the gas filling in the desired amounts an agent for modifying the radiation spectrum. This auxiliary device is preferably in the form of a mercury reservoir provided with means for liberating vapor.

A preferred form of my invention for illuminating purposes comprises an envelope containing an atmosphere of rare gas such as neon and having a reservoir of mercury. An alkali metal electrode and a cooperating electrode of any desired kind is provided for passing a discharge directly through the rare gas and another electrode is furnished for causing a discharge to be passed to the mercury in order to vaporize it. In order to secure the desired characteristics of illumination from the device means, such as resistances, inductances or capacitances may be provided for controlling the relative intensities of the discharges. For liberating the mercury suitable heating means may be employed in place of the auxiliary electrode. This heating means may comprise any suitable source of external heat, but preferably is in the form of a heating coil placed adjacent to the mercury reservoir and adapted to be energized by the discharge current.

When it is desired to secure a white light approximating that of sunlight, the filling of the envelope may be of neon gas used in conjunction with a reservoir or other means for supplying an exactly proportioned amount of mercury vapor. It is advisable where the tube is to be operated over a relatively long period of time to maintain the mercury vaporizing means in operation at the correct intensity during the entire operation of the device. It is, however, possible to start the discharge through the rare gas column and then supply the necessary quantity of mercury vapor for a short period of time, after which the device will continue to emit a white light for some time. As operation is continued the mercury is cleaned up, apparently either by condensation, occlusion, absorption or some other phenomena and the light emitted by the device gradually reverts to the characteristic color of the rare gas, which in the case of neon is substantially red. By operating the mercury vaporizing device at the correct intensity mercury vapor is supplied at the same rate at which it is used up and hence the color of the emitted light remains constant.

The alkali metal electrode is very important to the prolonged operation of the tube. This electrode appears to function as a clean-up agent for the excess mercury within the main body of the tube, because when an electrode of ordinary metal is used the tube turns entirely blue after a relatively short period of operation, and cannot be restored to its original mercury free color. During the operation of the discharge device a minute amount of mercury vapor is continuously generated by the auxiliary electrode and carried over into the main body of the tube, where it is excited by the main discharge current. When the exciting current is cut off this mercury vapor remains in the main tube and apparently forms an amalgam, or other association, with the alkali metal electrode, of such character that the mercury is not liberated from the electrode

during future operation of the device. Without the alkali metal the mercury vapor relatively quickly reaches such density in the main tube that only blue light is generated. The alkali also serves to reduce the cathode fall of potential. A single metal or alloy of alkali metal may be used. I find it preferable to use an alloy of potassium and caesium in the proportion of 90% to 10%. By using such a combination the cathode drop may be made as low as 55 volts. For commercial purposes potassium may be used alone to save expense.

The operating area of the alkali metal cathode should be so proportioned with respect to the discharge current that the current density will be of but moderate intensity, for example, 3 amperes per square inch or less so that large amounts of metallic vapor will not penetrate the main discharge path and mask the spectrum thereof. The alkali metal should be made the cathode during normal operation of the device for otherwise the excess mercury vapor is not absorbed or prevented from acting, by the metal.

For producing other colors of light other monatomic gases, for example, helium, argon, zenon, crypton, may be used with mercury vapor, or one of a mixture of the rare gases of a given characteristic color emission may be used in conjunction with the means for liberating the vapor.

Other objects and advantages and the manner of obtaining them will be made clear in the following specification and accompanying drawing.

The drawing shows a device constructed in accordance with my invention wherein the modification of the emitted spectrum is obtained by heating a quantity of spectrum modifying material.

Referring more particularly to the drawing, the figure illustrates an electrical discharge tube comprising a light transmitting envelope 1 filled with rare gas, such as neon, and having a pair of main discharge electrodes 2 and 3, the cathode 3 being of alkali metal and anode 2 of any well-known type, having the usual lead-in wires. The pressure of the gaseous atmosphere may range anywhere from .1 to 50 millimeters, but I find it preferable to use a pressure in the neighborhood of 6 millimeters. A reservoir for a quantity of mercury 4 is provided in the form of an appendix 5. For energizing the tube the main elctrodes 2 and 3 are connected across a suitable source of direct current 13 by means of conductors 6 and 7. Connected in series with the conductor 6 is an adjustable resistance 8. The mercury 4 is vaporized by means of a heating coil 11 included in series with the conductor 6 leading to electrode 2, and the heating effect is controlled by means of a variable shunting resistance 12. By varying the amount of heat produced by the coil 11, the effect of the mercury vapor may be controlled.

In operation a current is caused to pass from the source 13 between the two electrodes 2 and 3, thereby energizing the filling of rare gas and causing it to emit light having certain color characteristics. For example, where the rare gas is neon the light will be predominantly red. In order to modify these color characteristics the resistance 10 is adjusted so that a current passes through the heating coil 11 strong enough to vaporize a quantity of the mercury. The mercury vapor diffuses through the gas in the envelope 1, emitting light rays of its characteristic blue color. By properly adjusting the resistance 12 it is possible so to balance the blue rays emitted against the characteristic color of the rare gas as to produce a light emission of any desired color. For example, where the rare gas is neon a proper adjustment of the resistances 12 may be made to cause the emission of white light, the blue rays of the mercury being complementary to the red rays of the neon. The resistances 8 and 12 serve also as ballast resistances for balancing the negative resistance of the gaseous discharge path. These resistances should therefore never be cut entirely out of circuit as the discharge current would increase to an excessive value. While the mercury reservoir is illustrated as positioned near to one of the main electrodes it need not necessarily be so located. The device will likewise be operative with the reservoir at other positions. By placing the reservoir as shown the impedance of its discharge path is made relatively large.

It is well known that ordinary light tubes utilizing a filling of rare gas are adapted to operate at only relatively low current densities and that in order to secure life long enough for commercial purposes it has been thought necessary to utilize electrodes operating at relatively low current densities. A device constructed in accordance with my invention will, on the contrary, operate at extremely high current densities without excessive heating and without excessive deterioration.

Where neon gas and an auxiliary mercury electrode are used, as set forth, the color may be adjusted from the characteristic neon color, through white, to the characteristic mercury color. The efficiency of tubes constructed in accordance with my invention is extremely high. For example, when using neon gas with mercury vapor to produce a white light the amount of energy consumed is only about 0.20 watt per spherical candlepower. Because of this relatively high efficiency the amount of heat generated by the device is correspondingly small.

Lamps of this type are substantially silent in operation, especially when direct current is used. They are therefore of great value where a white, silent and relatively cool, high

intensity illuminating source is desired, as in the recording of synchronized sound pictures.

It will be obvious to those skilled in the art that the invention is capable of a wide variety of modifications and adaptations and that the present disclosure is intended merely to illustrate its nature without limiting its scope which is set forth in the appended claim.

What I claim is:

A lamp comprising an envelope, a quantity of rare gas within said envelope, an anode at one end of the envelope, a cathode at the other end thereof, a mercury chamber having connection with said envelope, an electric heater for said reservoir, said heater being coiled around said reservoir, electric means connected with said heater for regulating the heat developed by said heater and thereby controlling the amount of mercury vapor generated from said reservoir, an alkaline metal at the cathode end of said envelope, in spaced relation to said mercury reservoir, whereby mercury vapor in regulated quantities is supplied to the rare gas to modify the color thereof and mercury vapor is removed near the cathode end from the sphere of the light column by the said alkaline metal.

In testimony whereof: I have signed my name to this specification this 21st day of October, 1930.

CHARLES SPAETH.