Dec. 2, 1930. M. W. GARRETT 1,783,643

ULTRAVIOLET LAMP

Filed July 20, 1927

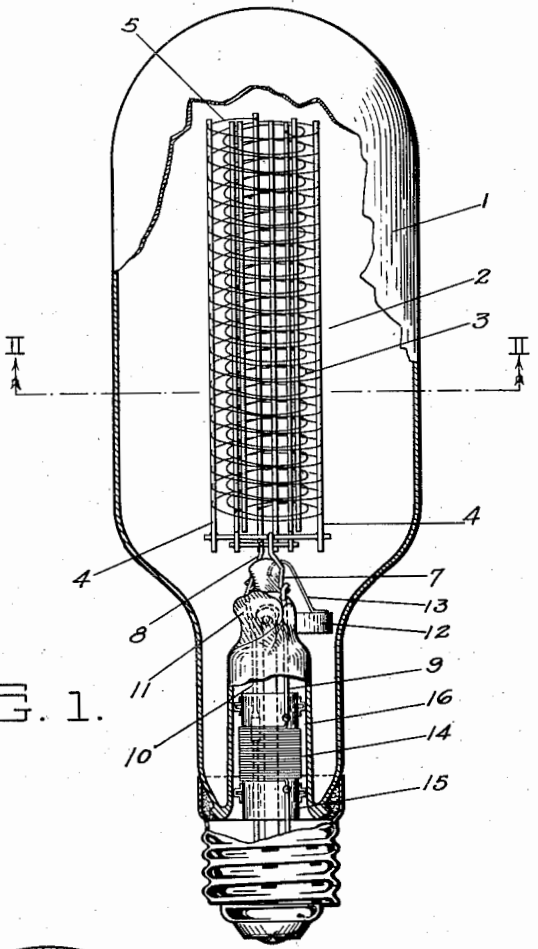

FIG. 1.

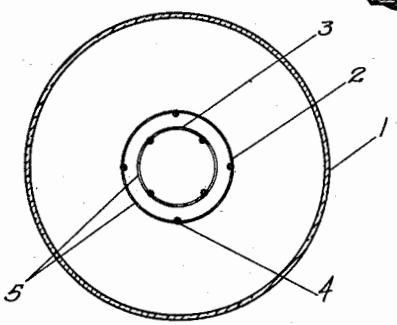

FIG. 2.

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UNITED STATES PATENT OFFICE

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ULTRAVIOLET LAMP

Application filed July 20, 1927. Serial No. 207,085.

This invention relates to a lamp for the production of ultra-violet radiations and more particularly to a gaseous conduction lamp of the negative glow tape yielding a spectrum which includes a large portion of the ultra-violet region.

The beneficial effects of ultra-violet radiations has been long recognized in therapy but heretofore the main available sources of artificial ultra-violet light have been the arcs of carbon, iron, mercury vapor, or tungsten, all of which require relatively high operating voltages, are relatively hard to control and require expensive auxiliary equipment for operation. Such sources have not been available for general applications.

One of the objects of the present invention is to provide a source of ultra-violet light suitable for clinical or household applications, which may be operated directly from 110 or 220 volt A. C. or D. C. supply mains without auxiliary equipment and which requires no more attention than the ordinary incandescent filament lamp.

Another object is to provide a lamp rich in ultra-violet light which is inexpensive to manufacture, which economical to operate and which will have a long life.

Other objects and advantages will hereinafter appear.

In accordance with the present invention, I provide a gaseous conduction lamp operating almost entirely with negative glow, as distinguished from positive column, having a gaseous filling composed mainly of a monatomic gas, such as argon, neon or helium, and containing a small proportion of a polyatomic gas, such as nitrogen, to yield the desired spectrum. The monatomic gas renders the starting and operating potential of the device relatively low and by some interaction with the polyatomic gas, not clearly understood, it appears to alter the spectrum thereof, and at least in certain mixtures, renders the spectrum more efficient in the ultra-violet region.

A strongly electro-positive metal, such as an alkali or alkaline earth metal is employed within the lamp to still further decrease the starting and operating voltages and render the lamp operable on the ordinary 110 volt circuit. A ballast resistance is employed to stabilize the discharge, preferably incorporated in the lamp structure, although, if desired, an external resistance of suitable value may be used.

In order that the invention may be more fully understood, reference will be had to the accompanying drawing in which:

Fig. 1 is an elevation, partly in section of a lamp embodying my invention; and

Fig. 2 is a sectional view on the line 2—2 of Fig. 1.

The construction illustrated in the above figures comprises an envelope 1 of any suitable material capable of transmitting the desired portion of the spectrum, such as quartz or special glasses transparent to ultra-violet radiations. A pair of concentric grid shaped electrodes 2 and 3 are mounted within the envelope, each of which consists of a number of longitudinal support wires 4 about which electrode wires 5 are helically wound and secured, as by welding at the points of contact. The electrodes are supported from the press 6 by rigid support wires 7 and 8, joined to current conducting leads 9 and 10, respectively, sealed through the press 11.

The envelope is filled with a monatomic gas or mixture of monatomic gases containing a small proportion of a polyatomic gas. In the specific modification illustrated, argon at 1 to 2 cm. pressure was employed, containing 2 to 3 mm. of nitrogen. Other proportions, however, may be used. The monatomic gas serves to permit the passage of current at a potential much lower than would be possible with the polyatomic gas alone, and while the spectrum of the argon is not strong in the ultra-violet region, yet the argon appears to aid in exciting the nitrogen spectrum to enhance the ultra-violet radiation. While the cooperative action of the monatomic gas is not fully understood, it is suggested that it may be due to collisions of the second kind or some similar interaction with the molecules of the polyatomic gas. In the case of the nitrogen-argon mixture, the spectrum is confined almost entirely to the

region extending from the lower limit of the visible spectrum to about 2500 Angstrom.

If desired, a small quantity of a vapor, such as mercury, may be employed to enhance the ultra-violet radiations either in place of the polyatomic gas or in addition thereto.

The electrodes 2 and 3 are composed of a metal which is chemically inert with respect to the polyatomic gas under the conditions within the device. Tungsten or molybdenum have been found to exert no substantial clean-up of the nitrogen, while iron electrodes very rapidly eliminate the nitrogen content of the device. Nickel is not as active as iron but its clean-up action is sufficient to render its use objectionable.

An alkali metal is introduced into the envelope to further decrease the starting and operating characteristics. I prefer to employ cæsium or rubidium for this purpose since, due to the high vapor pressure of these metals, they continuously form a deposit on the electrodes and thereby maintain the desired low voltage characteristics of the device more readily than do sodium or potassium. In order to obtain the alkali metal in the device in a pure condition, a stable, non-hygroscopic compound thereof, such as cæsium dichromate, is mixed with a reducing agent, such as silicon and the mixture introduced into the lamp in a metal capsule 12 supported by wire 13 sealed into a portion of the press 11. After the device has been exhausted, the capsule 12 is heated by high frequency induction currents to effect a reaction between the cæsium compound and the reducing agent, and to vaporize the cæsium into the envelope where it forms a deposit on the electrodes and other portions of the device. The gaseous filling may then be introduced.

While the alkali metals have been specified in the embodiment illustrated, it is to be understood that other strongly electro-positive metals may be employed, which will reduce the cathode potential fall and absorb impurities from the gaseous filling without cleaning up the particular polyatomic gas, the spectrum of which it is desired to obtain.

When employing the alkali metals, it is necessary to control carefully the relative proportions of the alkali metal and the polyatomic gas so that one does not nullify the effects of the other. If too large a quantity of the alkali metal is employed, it may clean-up the polyatomic gas to such extent as to impair the ultra-violet efficiency of the lamp, whereas, if too small a quantity is employed, it may all combine with the gas, forming, for instance, a nitride, so that the desired low starting and operating potentials are not obtained. I have found, however, that a balance may be obtained between the alkali metal and the polyatomic gas, by controlling the relative quantity of each. For instance, when employing cæsium and nitrogen, in the proportion of about 2 to 3 mm. of nitrogen to about 1.5 milligrams of cæsium per 100 cc. of bulb volume that a satisfactory balance is obtained in which neither nullifies the functioning of the other.

A ballast resistance 14 consisting of a resistance wire wound upon an insulating sleeve 15 is inserted in the hollow stem 16 and connected in series with one of the leading-in wires 9. Current is supplied to the electrodes 2 and 3 through a suitable base 17 of the standard design employed in incandescent filament lamps.

In order to operate the lamp, it is merely necessary to insert the same in the usual incandescent filament lamp socket and snap on the switch. The lamp may be operated directly from a 110 volt or 220 volt circuit without auxiliary equipment of any kind.

It is to be understood that in place of the concentric spiral electrodes 2 and 3 any other convenient form of electrodes may be employed such as the plain parallel plates, intertwined spirals or bee-hive construction in which the electrodes are spaced sufficiently close together, at the gas pressure employed, to restrict the discharge to the so-called cathode glow. The electrode structure shown has the advantage of permitting substantially all the ultra-violet radiations produced by the discharge to pass from the lamp without obstruction by solid portions of the electrode assembly.

Obviously many changes and modifications may be made in the invention without departing therefrom and I do not desire to be limited to the exact construction shown and described except in accordance with the appended claims.

What is claimed is

1. A source of ultra-violet radiations comprising an envelope containing electrodes between which a discharge may be passed and a filling of a monatomic gas in said envelope containing an admixture of nitrogen, said envelope being composed of a material transparent to the particular ultra-violet radiations desired.

2. A source of ultra-violet radiations comprising an envelope transparent to the ultra-violet radiations desired, a filling of a monatomic gas in said envelope containing a small proportion of nitrogen and means for ionizing said gaseous mixture to excite the ultra-violet radiations.

3. A discharge lamp for producing ultra-violet radiations comprising an envelope transparent to desired ultra-violet radiations, a mixture of a monatomic gas and nitrogen in said envelope, a pair of electrodes therein so spaced as to produce a discharge substantially all of the negative glow, said electrode being composed of a metal which does not react with the polyatomic gas to clean up the same.

4. A discharge lamp for producing ultra-violet radiations comprising an envelope transparent to desired ultra-violet radiations, a mixture of a monatomic gas and nitrogen in said envelope, a pair of electrodes therein so spaced as to produce a discharge substantially all of the negative glow, said electrode being composed of a metal which does not react with the polyatomic gas to clean up the same and a quantity of an electro-positive metal in the envelope for reducing the voltage drop between the electrodes.

5. A discharge lamp for producing ultra-violet radiations comprising an envelope transparent to such radiations, a monatomic gas therein containing nitrogen mixed therewith at a reduced pressure, a pair of electrodes in said envelope and an alkali metal therein, said alkali metal and the nitrogen being present in such relative quantities that neither becomes permanently completely combined with the other.

6. A discharge lamp for producing ultra-violet radiations comprising an envelope transparent to such radiations, a monatomic gas therein containing nitrogen mixed therewith at a reduced pressure, a pair of electrodes in said envelope and a quantity of cæsium therein, the cæsium and nitrogen being present in such relative quantities that neither becomes permanently completely combined with the other.

7. A discharge lamp for ultra-violet radiations comprising an envelope transparent to the desired ultra-violet radiations, a monatomic gas therein at a pressure of a few centimeters, a quantity of nitrogen therein at a pressure of a few millimeters, a pair of electrodes spaced so as to have a negative glow discharge passed therebetween, and a quantity of cæsium in the envelope for reducing the starting and operating characteristics of the lamp so that it may be operated on 110 volt lighting circuit.

8. A discharge lamp for ultra-violet radiations comprising an envelope transparent to the desired ultra-violet radiations, a monatomic gas therein at a pressure of a few centimeters, a quantity of nitrogen therein at a pressure of a few millimeters, a pair of electrodes spaced so as to have a negative glow discharge passed therebetween, a quantity of cæsium in the envelope for reducing the starting and operating characteristics of the lamp and rendering it operable on a 110 volt lighting circuit and a stabilizing resistance within said lamp in series with said electrodes.

9. A discharge lamp comprising an envelope containing a mixture of a monatomic and a polyatomic gas, electrodes therein and a quantity of an electro-positive metal in said envelope, said electro-positive metal and said polyatomic gas being present in such relative proportions that neither nullifies the functioning of the other.

10. A discharge lamp comprising an envelope containing a mixture of argon and nitrogen, electrodes within said envelope and a quantity of cæsium therein, said nitrogen and cæsium being present in such relative proportions that neither nullifies the functioning of the other.

In testimony whereof, I have hereunto subscribed my name this 19th day of July 1927.

MILAN W. GARRETT.