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H. C. RENTSCHLER ET AL

2,019,633

VAPOR ELECTRIC DEVICE

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Fig. 1.

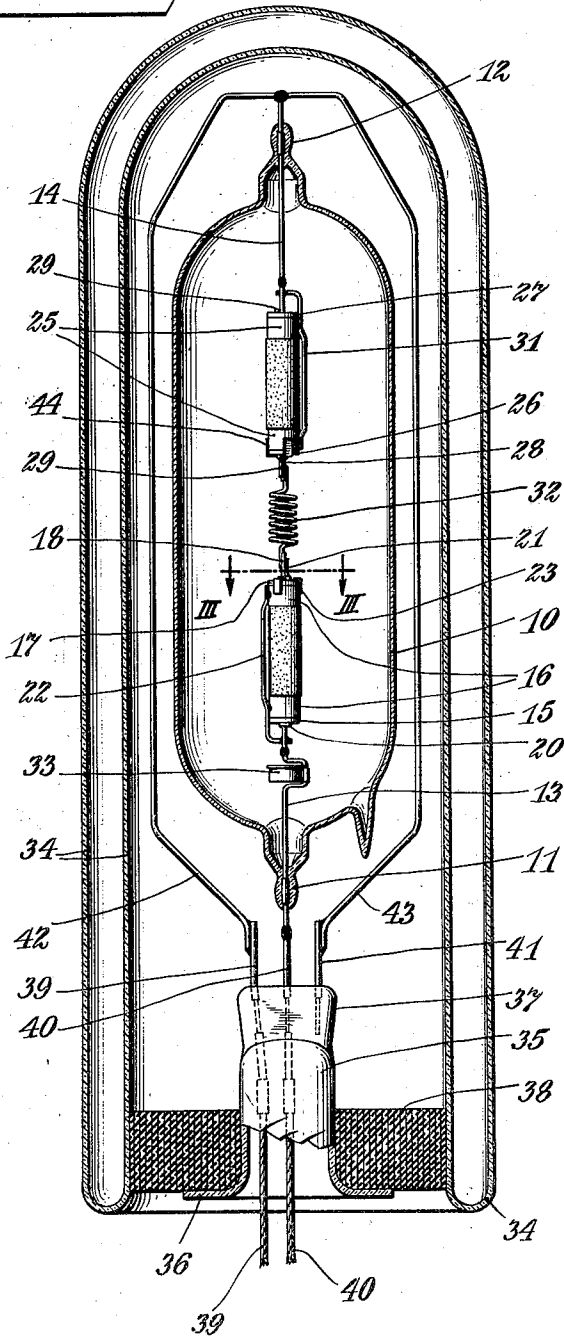


Fig. 2.

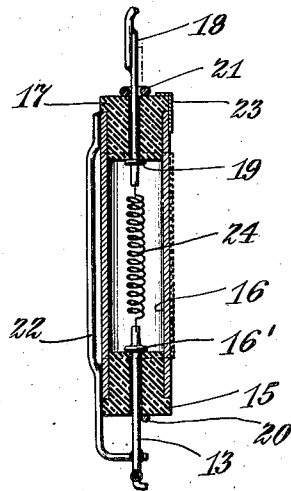
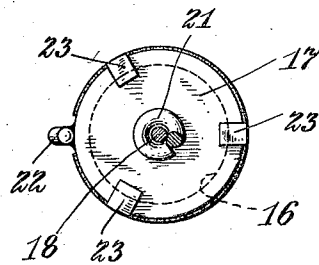


Fig. 3.



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VAPOR ELECTRIC DEVICE

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Application August 31, 1933, Serial No. 687,602

10 Claims. (Cl. 176—122)

This invention relates to an electric discharge device and more particularly to such a device that is adapted to be employed for illuminating purposes. More specifically the invention is an improvement over the device disclosed in the co-pending application of Harvey C. Rentschler and Donald E. Henry, which application was filed on August 30, 1933, bears Serial #687,391, and is assigned to the same assignee as the present application.

An object of our invention is to provide an electric discharge device of the metal vapor type whose efficiency is higher than that of similar devices of this character heretofore produced.

Another object of our invention is to provide a metal vapor lamp whose container has a substance therein for rendering ineffective deleterious gases which may be evolved or otherwise contained therein.

Another object of our invention is to provide an improved electric discharge device having indirectly heated cathodes so arranged with an expansion element for increasing the mechanical properties of said device during operation.

Another object of our invention is to provide an electric discharge device having an improved novel electrode structure therein.

A further object of our invention is to provide an electric discharge device which may be readily assembled and transported.

Another object of our invention is to provide an improved electrode structure.

Other objects and advantages of our invention will be perceived from the following description and drawing wherein,

Figure 1 represents a view in elevation with some parts in cross section of a discharge device embodying our invention.

Fig. 2 represents a cross sectional view of one of the electrodes embodying our invention.

Fig. 3 represents a cross sectional view taken on line III—III of Fig. 1.

Referring to the drawing, our electric discharge device which finds utility as an illuminating means comprises an elongated glass envelope 10 composed of boro-silicate glass resistant to sodium vapor. The ends of the envelope are in the form of outwardly extending presses 11 and 12 in which are hermetically sealed respective rigid leading-in conductors 13 and 14 which extend exteriorly and interiorly of said envelope.

An insulating plug 15 having a recessed portion defining a shoulder and a central opening through the depth thereof is located in one end of a coated nickel hollow cylinder 16, serving as an electrode.

The nickel cylinder has its ends uncoated, but that portion of the cylinder between said uncoated ends has a layer of good electron emitting material, such as oxides or carbonates of calcium, strontium and barium. That portion of the conductor 13 located adjacent the inner face of the end plug 15 is enlarged at 16' so that its cross sectional area is greater than that of the central opening of said plug. A similar plug 17 fits in the other end of said electrode 16, with a rigid conductor 18 extending through the central opening therein.

That portion of the conductor 18 within the cylinder has an enlarged section 19 bearing against the plug to prevent the conductor 18 from being withdrawn through said central opening.

A short nickel rod 20 is welded to the conductor 13 to prevent longitudinal movement of the plug with respect to the conductor 13. A nickel ring 21 is welded to the conductor 18 to prevent longitudinal movement of the plug with respect to the conductor 18. An L shaped conductor 22 has its short arm welded to the conductor 13 and its long arm to the uncoated section of the nickel cylinder 16. A plurality of spaced light but rigid nickel angles 23 are welded to the upper uncoated section of the cylinder 16 and bear against the plug 17 to further insure proper firm cooperation between the plug and cylinder. A helically coiled heater element 24, adapted upon incandescence to heat the electron emitting material to such a temperature that requisite electron emission takes place therefrom is welded to the rods 13 and 18. The electrode just described is located at one end of the envelope 10. At the other end of said envelope and symmetrically arranged with respect to said electrode is another electrode also comprising a nickel cylinder 25 having its ends uncoated and the portion between said uncoated portions being coated with a good electron emission material. A plurality of plugs 26 and 27 like the plugs 15 and 17, are located in the ends thereof. The conductor 14 and a short conductor 28 respectively extend through the central opening in the plugs 26 and 27. Each of these conductors have enlarged sections within the cylinder 25 which sections bear against the respective plugs. A ring or cross bar 29 is welded to the conductors 14 and 28 outside of the plugs for maintaining the plugs in position. A plurality of nickel angles 44 bear against the plug 26 and are welded to the electrode 25.

An L shaped rod 31 is welded to the conductor 14 and to the uncoated sections of the electrode 25. A coiled filamentary heater, not shown, and

similar to the heater 24 is welded to the rods 14 and 28 and is located in the cylinder 25.

An element 32 for mechanical expansion and contraction purposes and for other mechanical purposes is welded to the rods 18 and 28. The element 32 may be composed of nickel or copper and is in the form of a helically wound contraction spring for maintaining the parts in straight line position as shown.

Contained within said envelope which is first completely evacuated is a quantity of rare gas, such as neon, argon, helium. When argon is employed, it is preferably at a pressure of about 0.2 mm. of mercury. Together with the rare gas is a sufficient quantity of metal such as sodium, caesium, rubidium, zinc, cadmium or the like.

In the course of our experimentations with devices of this character we have found that the efficiency of devices employing oxide coated electrodes to be relatively low and generally not higher than about 22 lumens per watt. The voltage drop in these lamps we have found to be higher than was expected. We have further ascertained that the voltage drop depends upon the particular rare gas or combination of rare gases employed with the sodium as the atmosphere within the envelope.

The voltage drop is lowest when argon is employed, higher with neon-argon and still higher with neon. Our experiments disclose that the voltage drop was lowest and about 12 volts when argon is employed and about 15 to 17 volts when neon-argon is employed, depending, of course, somewhat upon the spacing between the electrodes and the gas pressure.

We believe that the low lamp efficiency is due in part at least to a deleterious gas, such as a diatomic or triatomic gas contained therein during the operation of said devices. Gases of this character, as for example carbon monoxide, oxygen, and carbon dioxide are liberated from the electron emitting material during bombardment thereof. When the oxides, such as barium, strontium and calcium are employed as the electron emitting means, they are generally prepared by coating with carbonates of these elements the nickel cylinder that is to serve as an electrode. The coated cylinder is then subjected to elevated temperatures whereby the carbonates are dissociated into oxides and carbon dioxide or carbon monoxide, the latter pass off as a gas. Even with the normal precautions taken, we do not believe that absolutely all of the carbonates have been converted into the oxides, but that there is some carbonate left in the coating after the heat treatment. This heat treatment is carried out with the parts all assembled and with the envelope connected to the exhaust pumps and maintained in a highly evacuated condition.

After the coating has been converted to an oxide, the envelope is sealed. Some of the pluro-atomic gases we believe are not entirely exhausted from said envelope, but are probably tenaciously retained by the inner wall of the envelope and the metallic parts contained therein.

During the operation of the device these gases may leave the envelope wall and the metal parts contained therein. In addition due to bombardment of the thermionically active oxide there are gases liberated therefrom. It is our opinion that probably part of the emission from a barium oxide containing coating is derived from barium suboxide and barium metal which might have been formed during the breaking down of the

carbonates. The residual carbonates contained in said oxide coating and probably some of the oxide are continually breaking down during the operation of the device to liberate carbon monoxide, carbon dioxide and oxygen. These gases are deleterious and, therefore, adversely affect the emission and the nature of the discharge. These gases poison the electron emitting coating to lower the quantity of emission that may be obtained therefrom. This poisoning action will probably be less when the device is operated on direct current than when operated on alternating current since the peak voltages when on alternating current are higher than the direct current operating voltage and inasmuch as some of this gas again disappears by being driven into one or the other electrode. The degree of gas disappearance in the electrodes is not the same and hence on A. C. operation this gas may partly be shuttled back and forth between the electrodes thus leaving more free gas at any one time than if operated on D. C. In addition the presence of these diatomic gases within the envelope introduces inelastic impacts between the electrons and the atmosphere within the envelope.

In order to obviate the above difficulties we have provided a means for increasing the efficiency of said device and this means we believe renders ineffective the deleterious gases that are present within said envelope. This means comprises an inverted metal cup 33 having a quantity of a clean up agent or getter, such as misch metal, magnesium or the like contained therein. The cup 33 together with its contents is welded or otherwise secured to the conductor 13 at a place below the cylinder 16 and has its open end facing away from said cylinder 16.

The getter material may be vaporized by means of a high frequency coil energization. The getter is deposited on to the end of the envelope adjacent the press 11. The getter reacts chemically with the deleterious gases to render the same ineffective during the operation of said device. After the getter is flashed in the lamp as heretofore described, we have observed that its efficiency may be as high as 29 to 33 lumens per watt. That is to say that the efficiency of a sodium vapor lamp is increased at least 30% when misch metal or similar getter is employed.

A misch metal gutter in a sodium vapor lamp lowered the voltage drop so that it was as low as 8 or 9 volts when argon was employed therewith, 11-13 volts when neon-argon was employed therewith, and 15-17 volts when neon was employed therewith. The values are, of course, not fixed because they depend somewhat on electrode spacing. Lower values may be obtained or the voltages may be somewhat raised by greater spacing. In substantially all cases the voltage drop is substantially uniform for different lamps employing the same atmosphere and electrode spacing.

The reason for the above surprising results which we have obtained is due to the fact that the diatomic gases that are contained within the device as originally prepared and/or evolved during operation thereof are now rendered ineffective. No longer can they poison the electrodes or reduce the elasticity of impact between the electrons and the atmosphere contained in said envelope.

An evacuated double-walled open-ended chamber 34 surrounds said device so that the proper temperature may be maintained during operation thereof. The chamber 34 and the lamp may

be supported by means of a stem 35 having a flare 36 of appreciable width and a press 37. Wrapped around said stem and having a portion thereof resting upon the flare is an insulator band or ribbon 38 of asbestos whose outermost lap frictionally bears against the chamber 34. Sealed in the press 37 are a plurality of rigid conductors 39, 40 and 41, which extend towards the envelope 10 and only the conductors 39 and 40 extend exteriorly of said stem. The conductor 40 is welded to the conductor 13 and the conductors 39 and 41 respectively are welded to rigid conductors 42 and 43 which extend along, but are out of contact with the envelope 10 and are welded to the exterior portion of the conductor 14. These rigid conductors serve as electrical conducting means and supporting means for the lamp.

Although our invention has been described with some particularity, it is to be limited only by the prior art.

What is claimed:

1. An electric lamp comprising an envelope, an atmosphere of a condensable alkali metal vapor and a thermionically active means therein, means also within said envelope for rendering ineffective gas derived within the space enclosed by said envelope which gas would normally lower the efficiency of said device when expressed in lumens per watt, said means having a low volatility characteristic preventing its forming a deposit throughout the envelope which would obstruct the passage therethrough of the generated light, said means having a higher activity towards the deleterious gas than does said alkali metal vapor, said means having a low combining power with said alkali metal.

2. An electric lamp comprising an envelope, an atmosphere of a condensable alkali metal gas and an electrode therein, said electrode comprising a metal base and a thermionically active oxide coating on said base and a getter therein for rendering ineffective by chemical action deleterious gas entering said atmosphere and which gas when normally present therein lowers the luminous efficiency of said device when expressed in lumens per watt, said means having a low volatility characteristic preventing its forming a deposit throughout the envelope which would obstruct the passage therethrough of the generated light, said means having a higher activity towards the deleterious gas than does said alkali metal vapor, said means having a low combining power with said alkali metal.

3. An electric discharge device comprising an envelope, an atmosphere of a condensable alkali metal gas and an electrode therein, said electrode having a thermionically active oxide surface and means therein for rendering ineffective a component of said surface which is derived therefrom and which when normally present in said device would lower the efficiency of said device, said means having a low volatility characteristic preventing its forming a deposit throughout the envelope which would obstruct the passage therethrough of the generated light, said means having a higher activity towards the deleterious gas than does said alkali metal vapor, said means having a low combining power with said alkali metal.

4. An electric discharge device comprising an envelope, an atmosphere of a condensable alkali metal gas and an electrode therein, said electrode including a metallic foundation and a thermi-

onically active oxide on said foundation and means within said envelope for rendering ineffective pluro-atomic gas liberated from said coating during operation of said device and which gas when normally present would lower the luminous efficiency of said device, said means having a low volatility characteristic preventing its forming a deposit throughout the envelope which would obstruct the passage therethrough of the generated light, said means having a higher activity towards the deleterious gas than does said alkali metal vapor, said means having a low combining power with said alkali metal.

5. A lamp comprising an envelope, an alkali metal and a thermionically active electrode therein, and misch metal within said device for increasing the luminous efficiency of said device when expressed in lumens per watt.

6. A lamp comprising an envelope, an alkali metal, a rare inert gas and a thermionically active electrode therein, said electrode comprising a metallic base and an oxide coating, and means located within said envelope at one end thereof for rendering ineffective a gas contained within said envelope which gas normally would lower the luminous efficiency of said device when expressed in lumens per watt.

7. An electric lamp comprising an envelope, an alkali metal, a rare gas and a plurality of electrodes therein, one of said electrodes having a metal base and an oxide coating thereon, and misch metal at one end of said envelope for rendering ineffective gas evolved from said oxide coating which would normally lower the luminous efficiency of the device when expressed in lumens per watt.

8. An electric discharge device comprising an envelope, having a plurality of presses, a plurality of electrodes in line and located in said envelope, conductors sealed in said presses and extending into said envelope, heater elements in series and electrically connected respectively to said conductors, said electrodes surrounding said elements and including thermionically active surfaces, said electrodes being electrically connected to said conductors, a thermal barrier at each end of said electrodes and a mechanical expansion and contraction element connecting said heater elements.

9. An electric discharge device comprising an envelope having a plurality of presses, a conductor sealed in each press, insulators having an opening therein through which said conductors pass, heater elements connected to said conductors, a coiled element connected to said heater elements, a metallic cylinder coated with a good thermionically active material surrounding said heater elements and having their upper and lower ends respectively closed by said insulators, other insulators closing the other ends of said cylinder.

10. An electrode structure comprising a hollow body coated with a good electron emitting material, an insulating plug, having a shoulder, located at each end of said hollow body, a heater element within said body, conductors passing through openings in said insulators and connected to said heater elements, means abutting an outer face of one of said plugs and secured to said hollow body for preventing said plug from moving away from said hollow body.

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