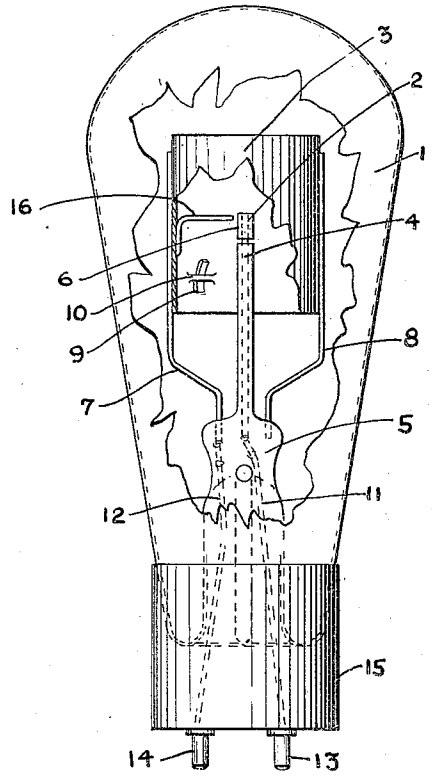
Aug. 9, 1932. H. C. RENTSCHLER 1,871,344

ELECTRON DISCHARGE DEVICE

Filed Jan. 3, 1927



INVENTOR
H.C. RENTSCHLER
BY
ATTORNEY

Patented Aug. 9, 1932 1,871,344

UNITED STATES PATENT OFFICE

HARVEY CLAYTON RENTSCHLER, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTINGHOUSE LAMP COMPANY, A CORPORATION OF PENNSYLVANIA

ELECTRON DISCHARGE DEVICE

Application filed January 3, 1927. Serial No. 158,503.

This invention relates to an electric discharge device having a glow discharge in a rarefied gaseous atmosphere and more particularly to the production of such a device utilizing a monatomic gas and a point-to-plate discharge in which the starting voltage and the operating discharge voltage fall within relatively narrow predetermined values and in which these voltages remain fixed within these narrow limits over a long period of time.

In my copending application Serial No. 59,986, filed October 2, 1925, entitled Electric discharge device and assigned to the Westinghouse Lamp Company, there is described and claimed a gaseous discharge device of the point-to-plate discharge type in which the anode or point electrode is composed of a metal of the cerium group of rare earth metals or a mixture of such metals, such as misch metal. Such device has a low starting potential and a low operating potential and is capable of use for controlling or regulating the plate voltage in radio receiving circuits, particularly where the plate current is obtained from rectified and filtered alternating current through the use of so-called "B"-battery eliminators. Other applications of the device are in connection with protective devices such as over-load circuit breakers, rectifiers, discharge lamps, etc.

While the characteristics of this device are admirable for the purpose for which it is designed, it requires a relatively long period of seasoning after manufacture to develop starting and operating characteristics. The misch metal anode has a relatively low melting point so that it is not possible to elevate the temperature thereof sufficiently to cause the gases and impurities therein to be rapidly driven off and consequently a long period of low temperature treatment is required to effect this result.

One of the objects of the present invention, therefore, is to produce a device having characteristics similar to the above device and in which the time required to develop the starting and operating characteristics is very substantially reduced.

Another object is to produce a gaseous discharge device having a long and uniform life.

Other objects and advantages will hereinafter appear.

I have found that when the anode of a point-to-plate discharge device utilizing an atmosphere of a monatomic gas such as argon or a mixture of monatomic gases consists of thorium, uranium or titanium and a vaporizable clean-up agent such as misch metal, is employed for purifying the gaseous filling and lowering the voltage drop through the device that the seasoning of the discharge device can be accomplished very quickly and simply and that both a low starting and operating potential may be obtained. The starting potential and operating potential, moreover, will fall within close limits and the device will operate continuously and uniformly without the characteristics thereof changing over a long period of time.

The misch metal may be attached to the cathode and vaporized therefrom by high frequency induction heating or by passing a heavy discharge through the device.

The misch metal appears to serve a double purpose in the device. In the first place, the residual impurities in the gas and those which come from the elements of the tube, such as insufficiently treated electrodes, will be cleaned up by the misch metal during the seasoning process. Also, during the operation of the tube the impurities which may be liberated from the internal parts of the device will be cleaned up and the gas maintained in a pure condition, thus keeping the operating characteristics of the device substantially constant throughout the life thereof. At the same time, the misch metal, due to its presence on the cathode, enables the device to have a lower starting potential and operating potential than would be obtained if the metal of the cathode were composed solely of one of the common metals, such as nickel, iron, molybdenum, etc.

The anode being composed of a relatively refractory metal may be substantially freed of its gas content after incorporation into the device by heating the electrode to a relatively high temperature by forcing a heavy

electrical discharge therethrough, thereby driving the gases and impurities from the electrode very quickly and facilitating the development of the starting and operating characteristics. The anode material acts itself as a clean-up agent during seasoning on alternating current and where low operating and starting potentials are not required, the misch metal may be omitted from the cathode and the purification of the gas effected entirely by the anode material. However, the use of misch metal on the cathode is preferred since it reduces the potential drop and improves the characteristics of the device.

In order that the invention may be more fully understood, reference will be had to the accompanying drawing in which the single figure illustrates a discharge device partly in section, employing the present invention.

The device comprises an envelope 1 containing an anode 2, a cathode 3 and a filling of a monatomic gas, such as argon or a mixture of such gases.

The anode 2 consists of a wire 4 of nickel or other suitable material sealed through the press 5 of the device and has a tip 6 consisting of thorium, uranium or titanium, secured thereon, although if desired the electrode may be composed entirely of one of the latter metals.

The cathode 3 consists of a cylindrical plate concentric with the anode and supported from the press 5 by support wires 7 and 8. The cathode may be composed either of iron or molybdenum. A quantity of misch metal 9 is secured to the cathode 3, in any suitable manner shown, the misch metal may be retained on the plate electrode by a strap 10 struck out from the electrode.

The anode and cathode are provided with current conducting leads 11 and 12 joined to the wire 4 and the cathode support 7 respectively and to the terminals 13 and 14 to the base 15.

To assist in starting the discharge, a projection in the form of a wire 16 extends from the cathode 3 into close proximity to the anode 2.

The envelope is preferably filled with argon at a pressure of about 5 to 7 millimeters of mercury, although other monatomic gases or mixture of gases may be employed, depending upon the characteristics of the device which are desired. The use of thorium, uranium or titanium as the anode material, renders it possible to employ a higher gas pressure than in the device disclosed in applicant's aforesaid application. This increase in the gas pressure gives considerably better life and less variation of voltage, for various currents when employed as a voltage regulator. For instance, with a gas pressure of about 5 mm. the voltage across the terminals may vary from about 84 to 92 volts with a current fluctuation of from 10 to 50 milliamperes, whereas with increased pressure of about 7 mm. the voltage variation will be reduced to from 86 to 90 volts.

After filling with the gas and sealing off, it is necessary to subject the device to a treating schedule to develop the starting and operating characteristics thereof. Preferably, such treatment consists in operating the device on 220-volt alternating current with a protective resistance in series therewith for a period of about 10 to 20 minutes and then seasoning the device on 110 volts alternating current for approximately one-half hour. Of course, the seasoning schedule may be varied within wide limits but should be continued until the electrodes are completely degassified and the impurities in the gas cleaned up as determined by the tube showing proper operating characteristics. I have found that a 40 or 60 watt tungsten lamp may be employed as the protector resistance for the device during the seasoning treatment. The misch metal is partly vaporized from the cathode preferably before filling with the gas and by the presence of the misch metal in the cathode it has a low potential drop. During seasoning, the misch metal on the cathode serves in addition to the anode material to clean up gaseous impurities.

Devices produced in the manner set forth above have a starting potential of from 100 to 125 volts and a minimum operating potential of about 80 to 100 volts, depending somewhat upon the gaseous content, its pressure, the current drawn by the device, etc.

The misch metal serves throughout the life of the device to maintain the gas in pure condition and the starting and operating characteristics uniform.

Due to the particular starting and operating characteristics, the device is particularly suitable for use as a voltage regulator for controlling the current supplied to a radio receiving apparatus from rectified alternating current where it is desired to maintain a constant voltage of around 90 volts. If it is desired to have a total plate voltage of 180 volts, two such tubes may be employed in series across the line and by means of suitable resistance, intermediate voltages of desired values may be obtained.

Obviously, the invention is susceptible to many embodiments and various uses and many changes and modifications may be made therein without departing from the invention.

In the appended claim it is to be understood that wherever the term thorium is employed, the metals uranium and titanium are to be considered as equivalents.

What is claimed is:

A gaseous conduction device comprising an enclosing envelope containing therein an inert gaseous filling, a thermionically inactive cathode and an anode composed substan-

tially of thorium, said cathode having a relatively large area as compared to the area of said anode and said cathode being coated at least in part with a metal of the cerium group of elements, said inert gaseous filling being at a pressure of about five to seven millimeters of mercury.

In testimony whereof, I have hereunto subscribed my name this 30th day of December, 1926.

HARVEY CLAYTON RENTSCHLER.