May 27, 1930. H. C. RENTSCHLER 1,760,524

ELECTRIC DISCHARGE DEVICE

Filed Oct. 2, 1925

FIG. 1

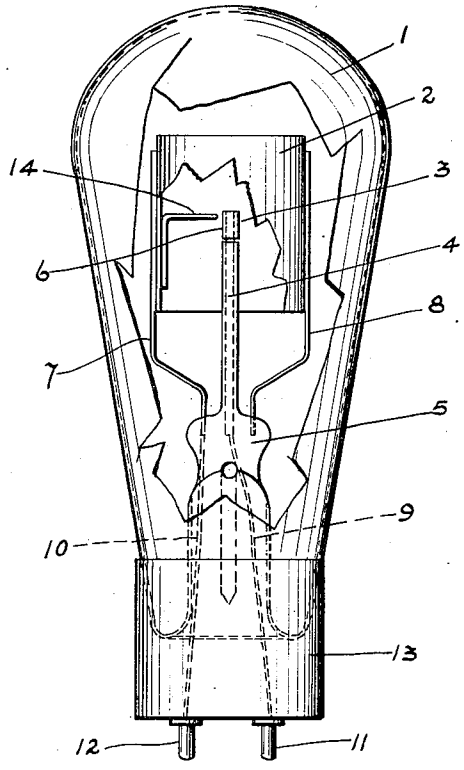
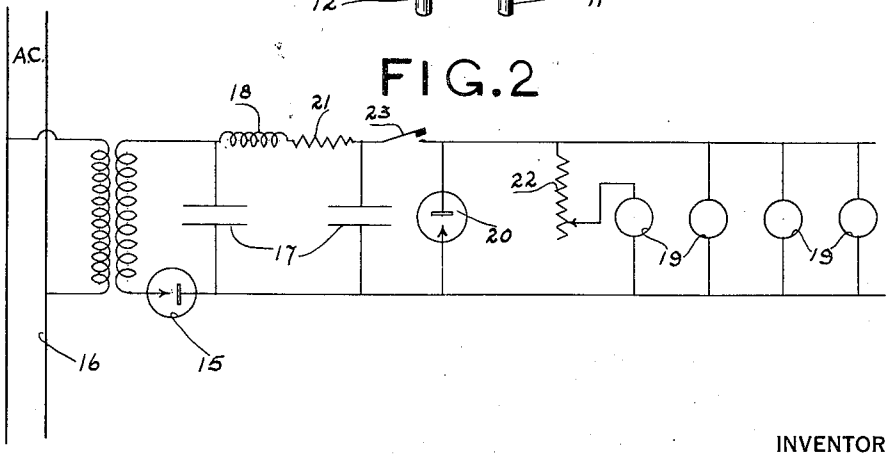


FIG. 2



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UNITED STATES PATENT OFFICE

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ELECTRIC DISCHARGE DEVICE

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This invention relates to electric discharge devices and more particularly to glow discharge devices in which the discharge takes place in a rarefied gaseous atmosphere.

The invention is especially concerned with the production of a discharge device utilizing a monatomic gas in which the starting voltage and the operating discharge voltage fall within rather narrow and predetermined values and in which these voltages remain fixed within these narrow limits over a long period of time.

Such devices may be used for controlling or regulating the plate voltage in radio circuits when the plate voltage is obtained from rectified alternating current, through the use of the so-called B-battery eliminators. Another use for this type of a device is in a glow discharge point-to-plate rectifier using an inert gas. Still another application of the device is in connection with protective devices, such as overload circuit breakers or the like. For all these purposes it is essential that the discharge start at a potential falling within relatively narrow limits and that the operating voltage is fairly definitely fixed within definite limits.

One of the objects of the invention is to provide a discharge device which will have a low starting potential and operating potential and which will be simple and rugged in construction.

Another object of the invention is to provide a gaseous discharge device of this nature which will be uniform and dependable in operation.

Another object is to provide a discharge device in which both the break down or starting voltage and the operation voltage fall within definite and relatively narrow limits.

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 misch metal or a metal of the cerium group of rare earths, that the seasoning of the discharge device can be accomplished very simply and that a low starting and operating potential may be obtained. Both of these potentials, moreover, will fall within definite limits and the device will operate continuously and uniformly within these limits over a long period of time. The misch metal appears to serve a double purpose. Residual impurities in the gas which come from the elements of the tube, such as insufficiently treated electrodes or which exist in the gas as impurities, 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 parts of the tube will be cleaned up and thus the operating characteristics of the device maintained uniform during the life thereof. At the same time some of the misch metal will be volatilized and condensed on the plate, thus giving a lower starting and operating potential than would be obtained if the metal of the plate were composed solely of one of the common metals used for purposes of this kind, such as nickel, iron, etc.

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

Fig. 1 illustrates a discharge device partly in section embodying the present invention; and,

Fig. 2 illustrates, diagrammatically, the method of utilizing the device for regulating the voltage.

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

The anode 3 consists of a wire 4 of nickel or other suitable material sealed through the press 5 of the device and has a strip of misch metal 6 clamped or otherwise suitably secured to the outer end thereof, although if desired,

the electrode may be composed entirely of misch metal.

The cathode 2 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 of nickel, iron, molybdenum or any other suitable metal.

The anode and cathode are provided with current conducting leads 9 and 10 joined to the wire 4 and the cathode support 7, respectively, and to the terminals 11 and 12 of the base 13.

To assist in starting the discharge, a projection in the form of a wire 14 extends from the cathode 2 into close proximity to the anode 3.

The envelope is preferably filled with argon at a pressure of from about 3 to 7 millimeters of mercury, although other monatomic gases or mixtures of gases may be employed depending on the starting and operating potentials desired. After filling with gas and sealing off, it is necessary to subject the device to a treating schedule to develop the starting and operating characteristic thereof. Preferably, such treatment consists in operating the device on 220 volt alternating current with a protective resistance in series therewith for a short time and then seasoning the device at 110 volts alternating current for several hours.

This treatment ionizes the gas and heats the anode to a sufficiently high temperature to render the misch metal active so that it is effective to thoroughly purify the gaseous filling. It also appears to render the cathode more sensitive or active and thus effective to initiate a discharge therethrough at a relatively low potential. It appears that a small proportion of the misch metal or some constituent thereof is sputtered, vaporized or otherwise deposited on the cathode from the anode. However, I do not desire to be limited by any particular theory.

Devices so produced have a starting potential of from about 100 to 125 volts and a minimum operating potential of about 80 to 100 volts depending somewhat upon the gas content. its pressure, the current drawn by the device, etc.

It is obvious that other treatments may be devised for developing the starting and operating characteristics of the device and that the invention is not limited to the particular treatment specified.

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

In some instances it may be desirable to use misch metal on the cathode as a getter in addition to its use on the anode. This would be particularly helpful if the gas used were not previously purified to a fairly high degree. If used on the cathode, the misch metal could be vaporized by high frequency induction or in any other suitable manner to clean up any impurities or common gases remaining in the gas filling.

Due to the peculiar starting and operating values, the device is particularly suitable for use as a voltage regulator for controlling the current supplied to radio receiving apparatus from a rectifier alternating source. The manner in which the regulator may be utilized for this purpose is illustrated in Fig. 2 in which direct current obtained from a suitable rectifier 15 from an alternating current source 16 is smoothed out and rendered uniform in value by the capacities 17 and inductance 18.

The rectified current may be used for any purpose such as the operation of the radio tubes or other device 19. The voltage regulator 20 is placed across the line to maintain the voltage constant irrespective of fluctuations in the voltage of the alternating current source or of the number of devices in operation. A resistance 21 is provided for limiting the current to the desired maximum value. A suitable resistance 22 may be provided to enable current of different voltages to be utilized.

Preferably, the resistance 21 is so regulated as to permit a current flow of approximately 50 milliamperes through the regulator at about 90 volts when the switch 23 is closed and the load 19 disconnected. This current is sufficient to supply the plate current of radio receiving apparatus having a relatively large number of amplifying tubes. When the tubes or other device 19 are brought into operation, so as to draw current from the rectifier, the regulator, maintains the voltage uniformly at the desired voltage, i. e., about 90 volts. Should the voltage fall below the minimum operating potential of the regulator, it ceases to operate and the full rectified current is available for the devices 19. Immediately, however, the voltage increases to the starting potential of the regulator, it again comes into operation. It is essential, therefore, in order to insure a restarting of the regulator, that its starting potential be relatively low and close to its operating potential. The starting and operating potentials of the described embodiment of this invention renders it particularly efficacious for this purpose.

It is obvious that the invention is susceptible of many embodiments and that various changes and modifications may be made therein without departing from the invention.

What is claimed is:

1. A discharge device comprising an envelope, a rare gas therein, a pair of electrodes in said envelope which function in the absence of thermionic activity and a quantity of metal of the cerium group of rare earth metals on one of said electrodes.

2. An electrical discharge device comprising an envelope containing a monatomic gas,

a small anode therein and a relatively large cathode, said anode being formed in part at least of misch metal whereby a low voltage discharge through said device may be obtained.

3. An electrical discharge device comprising an envelope containing a monatomic gas, electrodes therein operable in the absence of thermionic activity and a quantity of misch metal within said envelope for purifying said gas and reducing the starting and operating potentials thereof.

4. An electrical discharge device of the point-to-plate type comprising an envelope containing a rare gas, a small anode and a relatively large cathode therein and a metal of the cerium group of rare earth metals disposed on one of said electrodes adapted to purify said gas and reduce the starting and operating potentials of the device.

5. A glow discharge device comprising an envelope, a filling of monatomic gas therein at a relatively low pressure, and a plurality of electrodes within said envelope operable in the absence of thermionic activity, one of said electrodes being composed chiefly of misch metal, whereby said device has a low starting and operating potential.

6. An electrical discharge device of the point-to-plate type comprising an envelope containing a rare gas, an anode and a cathode, said cathode having a metal of the cerium group of rare earth metals disposed thereon.

7. An electrical discharge device comprising an envelope containing a filling of argon gas, an anode and cathode within said envelope, said anode being formed in part, at least, of misch metal and said cathode containing a quantity of misch metal on the surface thereof.

8. An alternating current rectifier having a low starting and operating potential comprising an envelope containing argon, a relatively large cathode and a small anode therein, one of said electrodes having the quantity of misch metal thereon adapted to reduce the starting and operating potentials of the device and maintain such potential uniform throughout the life of the device.

9. The method of reducing the starting and operating potential of a gaseous discharge device containing a plurality of electrodes which consists in introducing a quantity of misch metal therein on one of the electrodes, passing a discharge through the device at a potential of approximately 220 volts to activate the misch metal and subsequently reducing the voltage and continuing the discharge to season the device.

10. The method of reducing the starting potential of a point-to-plate rectifier of the gaseous discharge type comprising forming the anode of said device of a metal of the cerium group of rare earth metals and subjecting said device to a discharge sufficient to heat said anode to activate the cerium group metal.

11. The method of reducing the starting and operating potentials of a gaseous discharge device of the point-to-plate type comprising forming said point electrode partly of misch metal and treating the same to effect a transfer of a portion of said misch metal to the plate electrode.

In testimony whereof, I have hereunto subscribed my name this first day of October, 1925.

HARVEY CLAYTON RENTSCHLER.