

Dec. 12, 1939.

H. ALTERTHUM ET AL
GASEOUS ELECTRIC DISCHARGE DEVICE

2,182,779

Filed Aug. 22, 1938

Fig. 1.

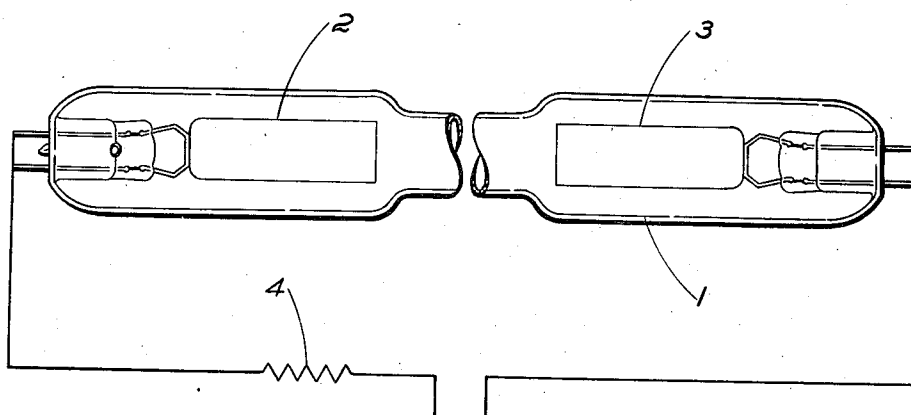
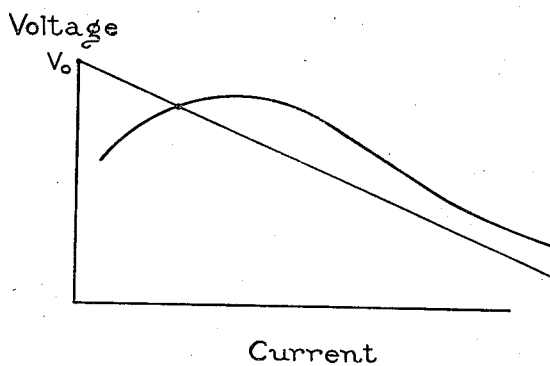


Fig. 2.



INVENTORS
Hans Alterthum
Arved Lompe
BY *Harry E. Sunham*
ATTORNEY

UNITED STATES PATENT OFFICE

2,182,779

GASEOUS ELECTRIC DISCHARGE DEVICE

Hans Alterthum, Berlin-Wilmersdorf, and Arved Lompe, Berlin, Germany, assignors to General Electric Company, a corporation of New York

Application August 22, 1938, Serial No. 226,189
In Germany September 17, 1937

3 Claims. (Cl. 176—124)

The present invention relates to gaseous electric discharge devices of the positive column type.

A particular object of the invention is to provide a gaseous electric discharge device which will have a positive volt-ampere characteristic, whereby the need for a series ballast is eliminated or greatly minimized. Still other objects of the invention will appear from the following detailed specification, or from an inspection of the accompanying drawing.

The invention consists in the new and novel structure hereinafter set forth and claimed.

It is well known that the positive column discharge in a gaseous electric discharge device has a negative volt-ampere characteristic under usual operating conditions—that is to say, that the voltage gradient in the discharge decreases with increasing current. It is for this reason that a series impedance has been used with all of these devices in order to stabilize the current.

We have now discovered that the need for such a series impedance is eliminated or greatly minimized with a neon device of the positive column type provided certain critical conditions are established. Thus we have discovered that by providing such a device with a filling of neon at a pressure within the range of from 4 to 8 mm. of mercury column the discharge has a distinctly positive volt-ampere characteristic at current strengths of a few up to 60 milliamperes, and a substantially constant voltage gradient for currents somewhat in excess of this, up to the order of 100 milliamperes, provided the neon contains an admixture of from 0.2 to 0.9% of krypton or xenon. With the higher percentages of added gas, however, the luminous efficiency of the device is greatly decreased, and hence we find it desirable to limit the percentage of krypton or xenon to the range of from 0.2 to 0.5%. This mixture of gases, at this particular pressure, in addition to providing a positive volt-ampere characteristic, as thus described, whereby the discharge is uniquely self-stabilizing, also results in an extremely low breakdown potential and re-ignition voltage which is but little in excess of the normal discharge maintaining voltage. As a result such a device will operate on a constant potential source either without a stabilizing impedance, or with at most only a small impedance to absorb the difference between the starting and maintaining voltages, which amounts at most to only 50 to 100 volts. This novel discharge device is thus not only extremely efficient, but also re-

quires a minimum of investment for auxiliary apparatus.

The reason for this unique and hitherto unknown reversal of the volt-ampere characteristic obtained with our novel construction cannot be stated, since previous theoretical concepts of the discharge do not suffice in this particular case. Measurements, however, confirm the fact that the voltage gradient in the positive column increases in a surprising manner in this novel device with increases in current, as hereinbefore stated, and also reveal that the voltage drop at the electrodes also increases in a surprising manner with increases in current where this novel gas mixture is used at a pressure within the critical range, especially where cold type electrodes are used.

In general we prefer to use either two cold cathodes or one cold and one hot or thermionic type electrodes, although where tubes having a relatively long positive column are involved, two thermionic cathodes are employed where desired, since under these circumstances the increase in voltage gradient in the positive column is sufficient to offset any possible decrease in the cathode fall at the thermionic cathode with increasing current. These devices will operate on either direct or alternating current. With operation on direct current, however, care is preferably taken to prevent undue separation of the gases by the electro-phoretic effect.

For the purpose of illustrating our invention we have shown a preferred embodiment thereof in the accompanying drawing, in which

Fig. 1 is an elevational view of a lamp constructed in accordance with the invention, and Fig. 2 is a graph showing the operating characteristics thereof.

As shown in Fig. 1 this novel lamp comprises a tubular envelope 1 of suitable vitreous material having an inside diameter of 20 mm. Within said envelope there are a pair of electrodes 2 and 3 which are separated by a distance of the order of 1 meter. As shown these electrodes consist of sheet iron cylinders 50 mm. long and 17 mm. in diameter. Where desired, one or both of the electrodes may be of the activated thermionic type. The envelope 1 is filled with neon intermixed with from 0.2 to 0.5% of krypton or xenon at a total pressure of from 4 to 8 mm., as hereinbefore described, but a preferred filling consists of neon containing 0.2% of krypton or xenon at a pressure of 6 mm.

With currents of the order of 100 milliamperes the volt-ampere characteristic is weakly negative,

and hence where a series impedance 4 is used the value of this impedance and of the applied voltage are preferably so chosen that it is impossible for the discharge to jump over onto this descending branch of the voltage-current curve. Thus as shown in Fig. 2 the curved line shows the relation between voltage and current in our novel device. The straight line drawn through the applied voltage V_0 (equal to breakdown potential) shows the voltage available for the discharge device at any current. This line is preferably steep enough that it intersects the curved line at the desired operating current value, on the rising portion of the curve, and then does not again intersect the curved line at higher currents. When the applied voltage is less than the highest voltage reached on the ascending portion of the curve, as in those cases where the ignition voltage is reduced to this value, or where a starting impulse or auxiliary electrodes are availed of to reduce the breakdown potential, impedance is, of course, entirely unnecessary, since then there is no tendency for the discharge to run away under any condition.

While we have illustrated our invention by reference to a particular embodiment thereof, it is to be understood that various changes, omissions and substitutions, within the scope of the appended claims, may be made in the structure shown and described without departing from the spirit of the invention.

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. In combination, a gaseous electric discharge lamp having a positive volt-ampere characteristic comprising a sealed tubular envelope, electrodes within said envelope and spaced to permit a positive column discharge therebetween, a gas

filling consisting of neon intermixed with from 0.2 to 0.5% of a gas from the group consisting of krypton and xenon within said envelope, said gas being at a pressure of from 4 to 8 mm. of mercury, and means to supply a current of from a few milliamperes to 60 milliamperes to said device, whereby said device operates stably with a positive volt-ampere characteristic.

2. In combination, a gaseous electric discharge lamp having a positive volt-ampere characteristic comprising a sealed tubular envelope, electrodes within said envelope and spaced to permit a positive column discharge therebetween, a gas filling consisting of neon intermixed with 0.2% of a gas from the group consisting of krypton and xenon within said envelope, said gas being at a pressure of 6 mm. of mercury, and means to supply a current of from a few milliamperes to 60 milliamperes to said device, whereby said device operates stably with a positive volt-ampere characteristic.

3. In combination, a gaseous electric discharge lamp having a positive volt-ampere characteristic comprising a sealed tubular envelope, electrodes within said envelope and spaced to permit a positive column discharge therebetween, at least one of said electrodes being of the cold type, a gas filling consisting of neon intermixed with from 0.2 to 0.5% of a gas from the group consisting of krypton and xenon within said envelope, said gas being at a pressure of from 4 to 8 mm. of mercury, and means to supply a current of from a few milliamperes to 60 milliamperes to said device, whereby said device operates stably with a positive volt-ampere characteristic.

HANS ALTERTHUM.
ARVED LOMPE.