Dec. 12, 1939. H. ALTERTHUM ET AL 2,182,777

GASEOUS ELECTRIC DISCHARGE DEVICE

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Fig. 1

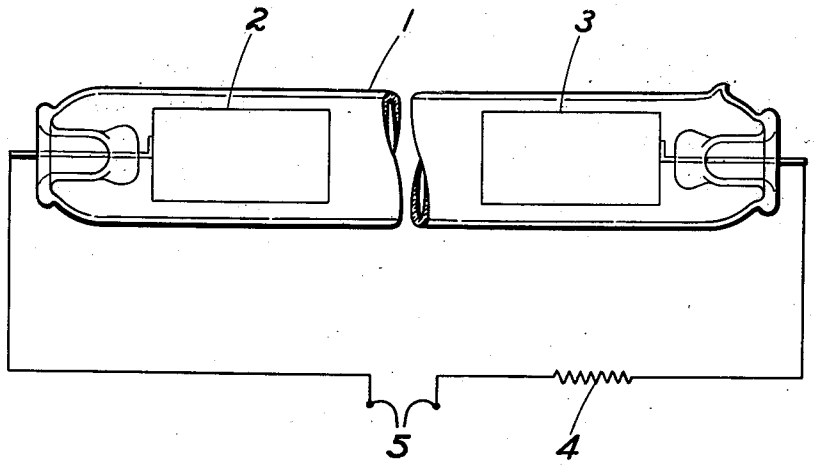
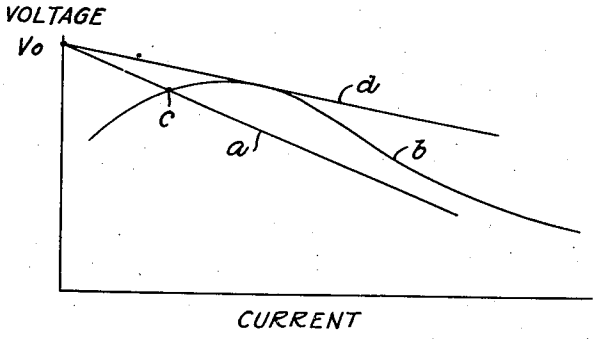


Fig. 2



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GASEOUS ELECTRIC DISCHARGE DEVICE

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3 Claims. (Cl. 176—124)

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

Gaseous electric discharge devices of the positive column glow discharge type, that is a discharge of high voltage and low amperage, are preferably provided with cold, hollow cylindrical electrodes and have neon therein at a pressure of about 1 to 20 mm. Such devices are useful in the advertising field. The starting potential of such devices is considerably higher that the operating voltage thereof and a series resistance is required for dissipating the excess voltage during the operation of the device. Even though the starting potential were no higher than the operating voltage a series ballast would still be required due to the negative volt-ampere characteristic of such devices and a high voltage current supply source would still be required for the same reason.

The object of the present invention is to provide a highly efficient gaseous electric discharge device of the positive column type having a gaseous atmosphere therein consisting of fixed gas and which has a positive volt-ampere characteristic.

We have discovered that when the total pressure of the fixed gas in a gaseous electric discharge device of the above type is from 4 to 8 mm. and when from 0.2 to 0.5% of argon is added to the neon the gaseous electric discharge lamp device has a positive volt-ampere characteristic over a current range of between a few milliamperes to the order of 50 to 100 milliamperes. At higher currents the volt-ampere characteristic gradually changes from positive to negative.

Due to the presence of argon the starting potential of the device is lower than when the device contains only neon and a comparatively small series resistance is sufficient for dissipating the excess voltage during the operation of the device. Since the device has a positive volt-ampere characteristic no ballast resistance is required which simplifies the circuit and increases the efficiency of the device by eliminating the waste of energy which takes place in such resistance.

It is essential that the total gas pressure and the percentage of argon be within the limits specified above if the advantages of the invention are to be secured. We have observed that when the percentage of argon is less than 0.2%, or when the pressure of the gaseous filling is less than 4 mm. the argon is absorbed after a comparatively short period of operation and the volt-ampere characteristic of the device changes from positive to negative. When the percentage of argon is higher than 0.5% the visible light output of the lamp is reduced so that the lamp device is less effective for advertising purposes. When the total gas pressure is greater than 8 mm. the device does not have a positive volt-ampere characteristic. Thus the total gas pressure and the percentage of argon are critical to success in the present invention.

The unexpected influence of the argon additions on a property of neon tubes which hitherto was thought to be unchangeable, cannot be explained by any of the concepts concerning gaseous electric discharge. We have demonstrated, however, by probe measurements, that the cathode drop at the hollow cylindrical electrodes, which is independent of current strength when pure neon is used in the device, increases with a rising current strength when the gas mixture of the present invention is used. Probe measurements also reveal that the volt-ampere characteristic of the positive column discharge, which is strongly negative with pure neon, is positive with the gas mixtures of the invention.

Devices embodying the invention are capable of operation on alternating current as well as on direct current but care should be exercised that electro-phoresis does not cause a separation of the two rare gas components and thus the loss of the desirable characteristics of the device resulting from the definite relation of the gases of the mixture. Thermionic electrodes are useful in devices embodying the invention but due to the negative volt-ampere characteristic of such electrodes we prefer to use one thermionic electrode which is either heated by the discharge or by a special heater current.

The operating circuit of the devices embodying the invention consists, as shown in Fig. 1, of means to supply a current of a voltage which is adapted to the other ignition facilitating agents on the device and a small resistance which dissipates the difference between this supply voltage and the operating voltage of the device. Due to the presence of argon a starting potential of about 50–100 volts above the operating voltage of the device is sufficient. With reference to Fig. 2 of the drawing, the supply voltage and the series resistance are preferably such that a straight line drawn through a point representing the voltage of the current source on the ordinate axis of a graph whereon a curve *b* representing the relation between voltage and current of the lamp is plotted and a point *c* representing the operating current and voltage of the lamp device

on the rising part of said curve is steeper than a line *a* drawn through the point on the ordinate axis representing the voltage of the current source and tangent to the aforesaid curve on the descending part thereof. (See Rudolph Seeliger "Physik der Gasentladungen" 2nd edition, 1934, starting at page 128.) A change in the volt-ampere characteristic of the device from positive to negative is thus avoided. This undesired change from a positive to a negative volt-ampere characteristic is avoided when the voltage supplied to the device, represented by the line *a*, is lower than the maximum voltage at which the device still has a positive volt-ampere characteristic.

In the drawing accompanying and forming part of this specification an embodiment of the invention is shown in Fig. 1 in a front elevational, partly sectional view, and

Fig. 2 is a graph showing the electrical characteristics of the circuit.

Referring to the drawing the gaseous electric discharge device comprises an elongated, tubular container 1 having cold sheet iron electrodes 2 and 3 sealed therein at each end thereof. Said container 1 has a gaseous atmosphere therein consisting of neon containing about 0.2% argon, the total pressure of the fixed gas being 6 mm. The container 1 has a diameter of 20 mm. and the electrodes 2 and 3 are separated a distance of 1 meter. The electrodes are 50 mm. in length and 17 mm. in diameter. The device has a resistance 4 connected in series therewith across the terminals of an alternating current source 5. Such a device operates stably without a series series ballast when the above current and voltage conditions are observed.

While we have shown and described and have pointed out in the annexed claims certain novel features of the invention, it will be understood that various omissions, substitutions and changes in the forms and details of the device illustrated and in its use and operation may be made by those skilled in the art without departing from the broad spirit and scope 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 device of the positive column type comprising a container, electrodes sealed therein, a gaseous atmosphere therein consisting of neon and argon, the total pressure of the gaseous filling being 4 to 8 mm., the argon being 0.2% to 0.5% of the neon and means to supply a current of from a few milliamperes to 100 milliamperes to said device whereby said device operates stably with a positive voltage-current characteristic.

2. In combination, a gaseous electric discharge lamp device of the positive column type comprising a container, electrodes sealed therein, a gaseous atmosphere therein consisting of neon and argon, the total pressure of the gaseous filling being 6 mm., the argon being 0.2% of the neon and means to supply a current of from a few milliamperes to 100 milliamperes to said device whereby said device operates stably with a positive voltage-current characteristic.

3. In combination, a gaseous electric discharge lamp device of the positive column type comprising a container, electrodes sealed therein, one of said electrodes being a cold electrode, another of said electrodes being a thermionic electrode, a gaseous atmosphere therein consisting of neon and argon, the total pressure of the gaseous filling being 4 to 8 mm., the argon being 0.2% to 0.5% of the neon and means to supply a current of from a few milliamperes to 100 milliamperes to said device whereby said device operates stably with a positive voltage-current characteristic.

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