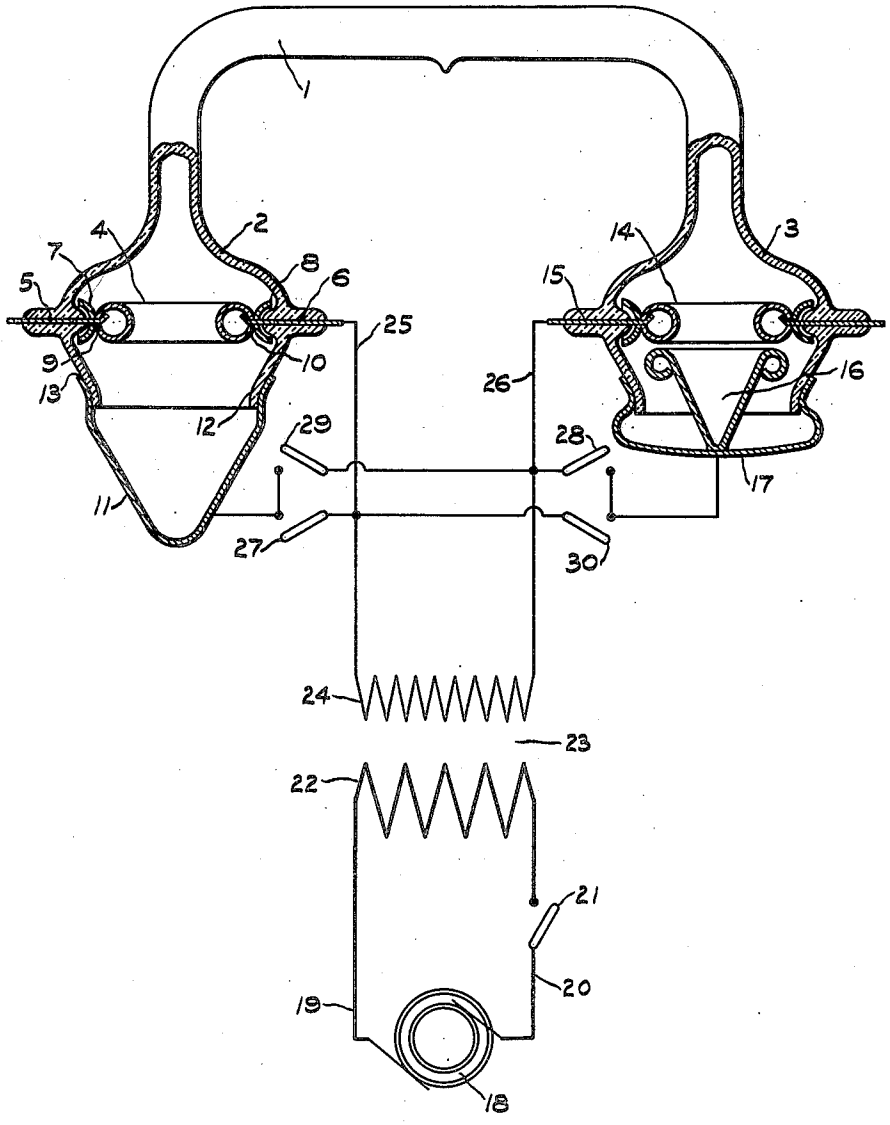
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LUMINOUS DISCHARGE DEVICE

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INVENTOR.

Montford Morrison

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LUMINOUS DISCHARGE DEVICE

Montford Morrison, Chicago, Ill., assignor, by mesne assignments, to Westinghouse Lamp Company, a corporation of Pennsylvania

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10 Claims. (Cl. 176—126)

The present invention relates to luminous discharge tubes of the gaseous ionization type, such as are used for illuminating advertising signs and the like.

Among the objects of my invention are; to provide an electrode construction for luminous discharge tubes which will discharge differently when acting as a cathode than when acting as an anode; to provide electrode construction having a rectifying characteristic such that one electrical end of the tube is provided with a pair of discharge surfaces having the property that one surface of the pair will discharge as a cathode mainly and the other surface of the pair discharge as an anode mainly; to provide improved cooling characteristics for the electrode surfaces and to provide an increased life and more stable operating characteristics than those devices of the prior art.

Further and other objects will be pointed out and obvious upon reading the specification, but the novel features of my invention are more particularly set forth in the claims.

Referring to the drawing, the figure represents one embodiment of my invention partly in elevation and partly in section, together with a diagrammatic view of one of the circuits which I use in the employment of my invention.

In the prior art it has been customary in making luminous discharge devices to construct them with similar electrodes for both ends of the discharge tube such that one electrode receives both the positive and negative discharge of the tube. In some cases a plurality of similar electrodes have been employed in each end of the tube, with provision for alternating the circuits external of the tube, but without any rectifying action.

In the employment of such a device it is necessary to supply means external of the tube for changing the discharge circuits, greatly complicating the device and adding very largely to not only the expense but the service problems connected with maintaining satisfactory operation of such a device.

In the present invention I employ an electrode having a shape such as to produce an electric field which in same cases under the influence of the discharge on the walls of the envelope will cause the discharge from one end of the tube when acting as an anode to distribute itself on one portion of the electrode, and when the same electrode is acting as a cathode, the discharge will distribute itself differently.

According to the nature of my invention, I may utilize an electrode which may be divided in two parts, or physically one.

One of the broad aspects of my invention is to provide an electrode surface having such geometrical form and so located with reference to the envelope wall, as to not only change the discharge distribution for a changed polarity, but in some cases change the discharge distribution as the voltage rises cyclically across the tube.

Rectifying action may be produced in a gaseous ionization tube in a number of different ways, and I do not limit my invention to any particular way of producing rectifying action in a gaseous ionization tube, the only limitation of my invention being that the electrode shape be such that when cooperating electrically with other electric field influences, it tends to produce a different discharge distribution upon the electrode surface when operating as an anode than it does when operating as a cathode. The discharge surface may consist of one physical piece or any number of physical individual parts electrically insulated or otherwise related to produce the above said only limitation.

In the drawing I have illustrated two different electrodes forming a part of the same discharge tube, illustrating two embodiments of my invention in the same figure, when considered individually and one embodiment when considered together.

1 is an elongated translucent tube at the ends of which are located enlarged chambers 2 and 3 containing the two forms of electrode structures of my invention.

4 is a hollow toroidal electrode being supported by sealed-in lead-in conductors 5 and 6, which conductors are provided with bombardment shields 7 and 8 which have already been fully discussed in one of my prior applications, Serial No. 256,916, filed February 25, 1928.

Sealed-in lead-in conductors 5 and 6 are fixed to toroidal electrode 4 at points 9 and 10, supporting this ring-like structure rigidly in the open space of the enlarged end 2. 11 is a cap usually of spun copper fitted to the end 12 of chamber 2 and sealed thereto around its circumference at 13.

Chamber 3 contains an electrode 14 which may be constructed and supported similarly to the way in which electrode 4 is constructed and supported. Electrode 14 is connected to the sealed-in lead-in conductor 15 for purposes of electrical connection hereinafter described.

Behind electrode 14 is located a cooperating surface 16 which may be physically a part of

electrode 14 or mounted individually as shown in the figure.

The chamber 3 has a cap 17 fitted to the said enlargement 3 and sealed thereto in the manner already described for the other tube end.

18 is an alternating current generator which by means of leads 19 and 20, through switch 21, supplies the primary 22 of transformer 23 with alternating current energy. 24 is a secondary of transformer 23 which through leads 25 and 26 supplies high potential energy to electrode surfaces 4 and 14.

The cap 11 can be electrically connected to lead 25 by means of switch 27, and the cooperating discharge surface of 16 may be connected to lead 26 by means of switch 28.

In some of the embodiments of my invention it is advantageous to have the cap 11 operate at the opposite instantaneous potential of electrode 4, and I have, therefore, provided switch 29 for accomplishing this result.

Likewise, in some cases it is advantageous to have the cooperating surface 16 disassociated from electrode 14 and operating at an opposite instantaneous polarity, and likewise, I have provided switch 30 for accomplishing this result.

Those familiar with the art of gaseous ionization phenomena appreciate that two electrodes located in a rarified gas and subject to electrical potential conduct the discharge energy between the electrodes qualitatively differently when the discharge tends to pass in one direction from what it does when the discharge tends to pass in the opposite direction, provided the two said electrodes are dissimilar. Almost any degree of dissimilarity produces some rectifying action, but I have discovered that when the electrodes are properly shaped, substantially 100% rectification can be attained.

Further, I have discovered that this rectifying action is due, at least, in part, to the distribution of the electric field surrounding the electrodes, and further, that a single electrode may be so shaped that the discharge from the one electrode may have one qualitative distribution when acting as cathode, and a different qualitative distribution when acting as anode. Further, that two separate electrodes may be employed having such shape that the anode discharge will be largely from one, and the cathode discharge largely from the other. The charge on the internal wall of the envelope also is a contribution further to the result as well as the shape of the wall and the location of the electrode with reference thereto.

In an enlarged discharge chamber such as 3, for instance, having a suitable contour, a generally hollow electrode such as 14, for instance, tends to focus the discharge stream when acting as a cathode. When electrode 14 is operating as an anode, considerable of the electrons in the discharge stream due to high velocity will go through the annular opening in electrode 14 and strike the surface 16, and in a similar way when electrode 4 is operating as a cathode, the discharge stream will tend to focus itself when acting as a cathode, and when acting as an anode, considerable of the electron discharge will go through the annular opening 4, striking cap 11.

This action will hold true with cap 11 electrically free from electrode 4, as well as when electrode surface 16 is electrically free from electrode 14, though in some cases I prefer to close switches 27 and 28 under operation, which is also an operable connection.

If switches 27 and 28 are left open, and switch 29 and 30 are closed, a more pronounced rectifying action is obtained under some conditions of operation.

With reference to the operation of my device, alternator 18 supplying energy to transformer 23 excites electrodes 4 and 14 with high voltage. The electrodes 4 and 14 discharge through the tube 1, each tending to focus somewhat into the opening of the ends of the tube 1.

The exact field distribution, and consequent focusing present, depends upon the shape of the walls 2 and 3, and its relation to electrodes 4 and 14. Also, the pressure of the gas content in the rarefied envelope is an influencing factor.

This focusing is further influenced by discharge conditions in the tube depending upon the amount of charge taken by the glass walls of the envelopes 2 and 3.

Under one set of conditions the discharge tends to focus somewhat from electrode 4, passing through tube 1, and due to the sub-atomic particle velocity, some of the discharge passes through the opening in 14 to the conical shaped part 16. And vice versa, when 14 is acting as a cathode, the discharge focuses somewhat toward the nearest opening of the tube end 1, passing through tube 1, and for similar reasons considerable of the discharge passes through the opening in 4 to the cap 11.

By properly shaping and properly locating my electrodes with reference to the walls 2 and 3 of the envelope, it will be appreciated that the charge taken on by the walls of the envelope will be influenced by the degree of excitation upon the electrodes, and this wall charge in turn changes the field distribution within the tube, causing the discharge distribution from the surface of the tube to change somewhat with the increase in voltage value, thereby bringing about the result of a change in discharge distribution about the electrode surface for changing the excitation for the tube.

Further, it will be appreciated that in any of the described cases the discharge stream tends to distribute itself differently with respect to the various discharge surfaces when the particular end under discussion is operating as an anode from that when the same end is operating as a cathode.

This difference in distribution of discharge tends to heat the electrodes more uniformly and thereby reduces the vaporization of the said electrodes under operation, making possible the use of smaller electrodes with more stable operation. I find further that this structure reduces the sputtering action in the electrodes.

Having described one embodiment of my invention, I claim:

1. In a luminous discharge device, the combination of an hermetically sealed envelope, a rarefied gas subject to electric discharge within said envelope, a pair of electrodes for instituting said discharge when electrically excited disposed within said envelope, and a target adjacent each of said electrodes in the path of said discharge extensively exposed to the atmosphere for receiving part of the discharge bombardment during operation of said device.

2. In a luminous discharge device, the combination of an hermetically sealed envelope, a rarefied gas subject to electric discharge within said envelope, a pair of electrodes within said device for instituting said discharge when electrically excited, and a target adjacent each of said electrodes in the path of said discharge extensively

exposed to the atmosphere and constituting a seal for said envelope for receiving part of the discharge bombardment during operation of said device.

3. In a luminous discharge device, the combination of an hermetically sealed envelope, a rarefied gas subject to electric discharge within said envelope, a pair of coaxially disposed electrodes at each end of said envelope for instituting said discharge when electrically excited and one electrode of each pair being extensively exposed to the atmosphere, and means for electrically exciting said device to cause one electrode of one pair to operate principally as anode when one of the electrodes of the other pair is operating as cathode, and the remaining electrode of one pair to operate principally as cathode when the remaining electrode of the other pair is operating as anode.

4. In a luminous discharge device, the combination of an hermetically sealed envelope, a rarefied gas subject to electric discharge within said envelope, a pair of coaxially disposed electrodes located in one end of said envelope, one of said electrodes being extensively exposed to the atmosphere and means for electrically exciting said device to cause one of said electrodes to receive the majority of the said discharge under negative excitation and the other of the said electrodes to receive the majority of the said discharge under positive excitation.

5. In a luminous discharge device, the combination of an hermetically sealed envelope, a rarefied gas subject to electric discharge within said envelope, a pair of electrodes at each end of said envelope disposed coaxially with respect to each other for instituting said discharge when electrically excited, one electrode of each pair being supported within said envelope and the remaining electrode of each pair constituting a seal for said envelope and having its exterior surface exposed to the atmosphere, and means for electrically exciting said electrode to cause one of said electrodes of each pair to focus the said discharge when acting as cathode and allow a substantial amount of said discharge to pass by said electrode when acting as anode.

6. In a luminescent discharge device, the combination of a hermetically sealed envelope, a rarefied gas subject to electric discharge within said envelope, a set of coaxially disposed electrodes located within said envelope for instituting said discharge when electrically excited, and a target adjacent each of said electrodes in the path of said discharge electrically free from said electrodes and extensively exposed to the atmosphere, said target adapted to receive part of the said electric bombardment during operation of said device.

7. In a luminescent discharge device, the combination of a hermetically sealed envelope, a rarefied gas subject to electric discharge within said envelope, a pair of coaxially disposed electrodes at each end of said envelope for instituting said discharge when electrically excited, one electrode of each pair constituting a seal for said envelope with its exterior surface exposed to the atmosphere, and means for selectively exciting the electrodes of each pair with opposite instantaneous polarity and with like instantaneous polarity.

8. In a luminous electrical discharge tube, the combination with an elongated glass tube containing a gas which serves as a current conducting medium and having electrodes at the ends thereof, of means for controlling the stream of ions in the vicinity of the electrodes comprising an element of electrically conductive material within the tube adjacent the inner end of each electrode and adapted to receive an electrical charge of a potential different from that of the electrode.

9. A luminous electrical discharge tube having a cup-shaped electrode, and an annular element of electrically conductive material within the tube adjacent the edge of the cup-shaped electrode.

10. A luminous electrical discharge tube, the combination with a cup-shaped electrode having its open end presented to the stream of ions within the tube, of means for controlling the stream of ions in the vicinity of the electrode comprising an element of electrically conductive material in the tube adjacent the open end of the electrode.

MONTFORD MORRISON.