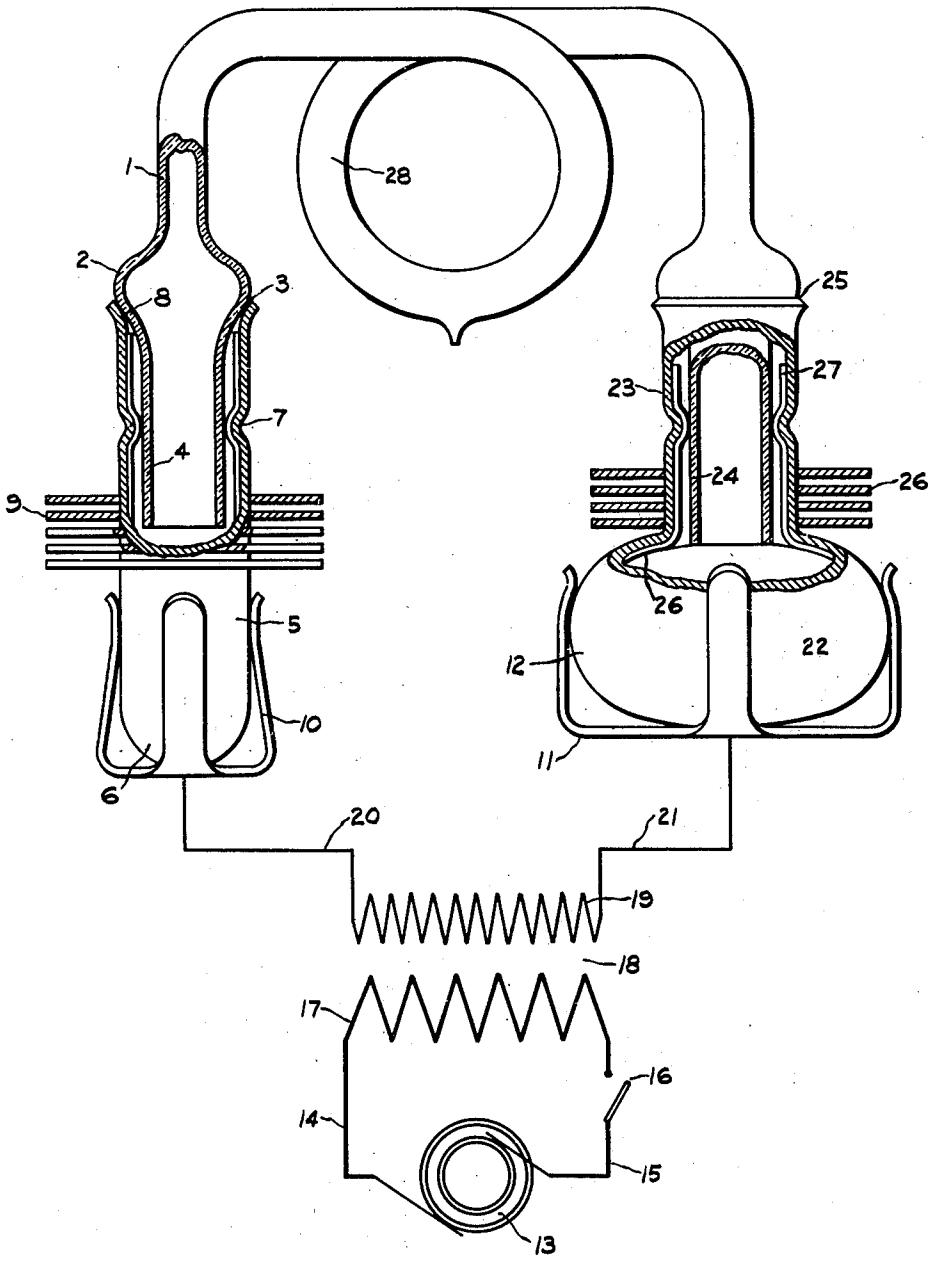
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LUMINOUS DISCHARGE DEVICE

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INVENTOR.

Montford Morrison

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MONTFORD MORRISON, OF MONTCLAIR, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WESTINGHOUSE LAMP COMPANY, A CORPORATION OF PENNSYLVANIA

LUMINOUS DISCHARGE DEVICE

Application filed February 25, 1929. Serial No. 342,463.

The present invention relates to luminous discharge tubes of the gaseous ionization type such as are used for illuminated advertising signs and the like. This invention is constituted of some of the elements disclosed in my Patent No. 1,842,624 issued January 26, 1932, and is in part a part thereof.

Among the objects of my invention are; to provide electrodes which have surface characteristics which eliminate excessive electrostatic field concentration about the discharge surface of the electrodes; to provide electrodes which operate at a lower temperature by providing cooling for the electrodes in direct contact with the surrounding air; to provide for the reduction of electrode vaporization and sputtering; to provide electrode seals which are shielded from positive ionization bombardment under operation, to provide electrodes which are fixed in firm contact with the walls of the discharge tube; to provide an electrode which can be transported with substantially no strain upon the seal, and to provide electrodes adapted to be held in a receptacle.

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.

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

In the prior art it has been customary in making luminous discharge tubes to provide a long restricted tubing with bulbous glass ends in which said bulbous ends are provided internal electrodes. Internal electrodes have serious disadvantages, among which is the inability of the electrode to radiate the heat generated in it advantageously and as a result of which the electrode not only gives off gas during operation but further vaporizes some of its constituted elements both of which are very detrimental to the operation of the tube.

In the present invention I have gotten entirely away from all of these internal electrode structures and have provided an electrode which is external of the end of the restricted tubing and thereby I not only remove a great many mechanical limitations, but bring the electrode itself into direct contact with the air which provides any degree of cooling desired. In some cases I may provide heat radiators attached to the electrode used in my invention to further reduce the operating temperature of the electrode.

The present invention is particularly differentiated from those of the prior art by the electrode being external of the glass tube, the ends of which tubing are open. The invention is further differentiated from those of the prior art in that the electrode is in firm contact with the walls of the tube itself, and the electrode proper may be sealed directly to the wall of the glass tube.

This structure further provides for the making of strong mechanical joints together with well supported structures which greatly contrasts itself with the fragile devices of the prior art.

My electrode construction further provides, by the employment of electrostatic field distribution accomplished by the shaping of the electrodes, a novel means of utilizing electrostatic surface characteristics, more fully disclosed in my prior application above referred to, in such a way as to direct considerable of the discharge and metallic vapors away from the glass walls of the tube and thereby tending to make this said vaporized metal condense on the electrode itself.

The present invention further provides for the constructing of individual letters and installing them by the simple process of inserting the electrodes into proper receptacles. If and when burn-outs occur, highly skilled labor is not required to remove or replace parts as the operation is more simple than removing or replacing ordinary incandescent lamp bulbs.

Referring to the figure, 1 is a translucent tube which may be bent into any shape as indicated in the figure at 28, and may be provided with an expanded portion 2 having a conical surface 3 and extended portion 4. One form of my electrode proper is shown at

5, which has the form of a thimble with a closed end 6 and a recessed annular groove 7 to rest upon the extended portion 4 and a flared conical surface 8 adapted to fit the conical surface 3 of the tube 1.

In practice the main body of my electrode 5 may be made of any suitable material, one example of which is copper, and the translucent tube at 2 may be made of any suitable material such as glass, for instance that known to the trade as 702–P. By proper preparation, heating and manipulation the glass and copper may be sealed at point 3 by one skilled in the art to which my invention appertains.

In some cases I may make the entire tubing 1 of the same glass or I may use a different material or glass for the restricted portion of the tubing 1 and seal it either directly to the material at the expanded portion 2 or include in between these two materials a third material more suitable to be fused to both. For instance, if it is made of glass known to the trade as Pyrex, I can with some difficulty seal this directly to the 702–P at 2, but in most cases I prefer to use a "step" of glass in between the two known to the trade as "Uranium glass". This Uranium glass seals more readily to both Pyrex and to 702–P than does 702–P seal directly to Pyrex.

The depressed annular groove 7 serves to hold the major portion of the electrode 5 away from the glass extension 4, and it serves to prevent the heat from the electrode 5 under operation from cracking the glass 4.

I have discovered that in the construction of my electrodes in some cases there seems to be a considerable advantage in employing a material for the discharge surface of my electrode, which material in some cases is not easily formed into the desired electrode shape and further, in many cases the material most desirable for the electrode discharge surface is too expensive for the application; in addition to which in many cases the desired discharge surface materials lacks several physical characteristics to make it desirable for use as an electrode body.

In desirable cases I prefer to coat my electrode with a more suitable material for the electric discharge surface than that out of which the body of the electrode is made and in which case I provide a coating indicated at 27. This coating may be of any suitable material whatever provided it reduces sputtering and/or vaporization of the electrode surface.

One suitable material I find to be thorium and this may be deposited upon the discharge surface of the electrode by any means whatever, for instance by the method disclosed in my Patent No. 1,506,852 issued September 2, 1924, though I do not limit myself to this process. In some cases it may be advantageous to electroplate a desirable coating upon the electrode and use a different material such as, for instance, cadmium. Some other processes which may be used to produce such an electrode will be found in my Patent No. 1,615,994 issued February 4, 1927.

The sealed joint at 3, being made to fit tight before being fused together, provides with the annular depression 7 a very strong and substantial support for the electrode 5, and because of this well fitting structure at two different places independent of the fusing itself, there is substantially no mechanical strain on the fused joint proper.

In some cases I desire to provide a plurality of heat radiators 9 to further cool the electrode and to divert the heat from the electrode away from the glass and the glass seal.

12 is a modified electrode in which 22 is an ellipsoidal enlargement of the cylindrical surface 23. The electrode 12 has a cylindrical glass projection 24, similar to that in electrode 5, being sealed at 25 similar to the seal 3, and having a generally flat surface 26, being in or near the plane of the cylindrical end of the projection 24.

By a theorem in electrostatics relating to the distribution of electrostatic fields from surfaces, as more fully discussed in one of my prior above referred to applications, the electrical discharge from the surface within the bulbous portion 22 is substantially orthogonal to the discharge surface in the immediate neighborhood thereof, and, therefore, the discharge from the inner wall of this electrode is largely away from the actual wall of the glass and tends to combine in such a way as to largely concentrate itself within the general center of the projection 24.

Apparently in such discharge devices, vaporized particles seem to move somewhat in a straight line from the surface from which they originate, and seem not to be influenced at least totally by the electrostatic field distribution. It will be observed from consideration of the interior contour of the hollow ellipsoid 22 that very few particles originating from the internal electrostatic surface of this electrode will strike the glass walls of the tube, at least a very small percentage as compared with the internal electrodes of the prior art. Electrode 12 may be further provided with heat radiators 26, the same purpose as those provided for electrode of the construction 5.

I further provide receptacles 10 and 11 which are adapted to receive the electrodes 5 and 12. With this construction it will be appreciated that the entire luminous discharge device can be removed from the receptacle or plugged into it without the aid of skilled labor, the complete luminous dis-

charge device being removed from the receptacles by pulling the device away from the receptacles along the axis of the electrodes.

13 is an alternating current generator which by means of leads 14 and 15, through switch 16, supplies primary 17 of transformer 18 with alternating current energy. Secondary 19 provides alternating current excitation for receptacles 10 and 11 through leads 20 and 21. In this way the receptacles 10 and 11, and hence electrodes 5 and 12, are provided with alternating current energy.

In constructing a completed tube, ordinarily I provide the tube 1 with two electrodes, as illustrated by 5 or 12, the tubing being gas-tight and the whole device prepared, degasified, evacuated and filled with any desired gas and sealed off of the pumps, as is well understood by those skilled in the art to which my invention appertains.

In the operation of my device, it will be appreciated that substantially all of the discharge from electrodes 5 and 12 comes from those portions beyond the extensions 4 and 24. The discharge passes from electrode 5 through the tubing 1, and thence to electrode 12, completing the electrical circuit. In this manner of operation the heating of the electrode in the vicinity of 7 is very little, and substantially only by conduction, and where I provide heat radiators 9, this conducted heat from 5 towards 7 is largely diverted into the surrounding air.

In any case, it will be appreciated that electrode 5, for instance, is under operation with the external surface of the electrode being in direct contact with the surrounding air, and this greatly lowers the electrode temperature below those of the prior art in which the electrode was totally enclosed within the bulbous glass portion of the prior art. In this way very little difficulty arises in the employment of my invention from heated electrodes either vaporizing or degasifying greatly under operation.

The characteristics of this invention, which has to do with elimination of concentrated electrostatic fields adjacent the discharge surface of the electrodes, presents itself by virtue of the radii of the curvature of the internal surfaces of the electrodes 5 and 12, particularly that surface subject to electrical discharge. This phase of my present invention is so fully covered in the heretofore mentioned co-pending applications of the applicant that its function with reference to the present invention will be better understood by those skilled in the art by reference to the aforesaid applications.

Having described one embodiment of my invention, I claim:

1. A gaseous ionization electrical discharge device comprising a translucent tube with a spaced extension end and a hollow metallic electrode of relatively large area surrounding said tube end and sealed externally to a small area thereof to provide a substantial spacing between the greater portion of the area of said tube end and said surrounding electrode, said electrode being operated internally at sub-atmospheric pressure and externally at atmospheric pressure.

2. A gaseous luminous discharge device comprising a translucent tube containing a rarefied gas, and an electrode having two small annular portions of its internal surface in contact with said tube, one of said annular portions being sealed to said tube, and the entire external surface of said electrode being exposed to the air surrounding the said device, whereby the heat generated in the said electrode, under operation, is permitted to radiate into the said surrounding air by direct contact with said air.

3. A gaseous ionization electrical discharge device comprising a translucent tube containing a rarefied gas and a hollow electrode mounted upon one end of said tube and supported thereby by two small annular portions of the internal surface of said electrode.

4. A luminous discharge device comprising a translucent tube with a spaced extension end containing a rarefied gas and provided with electrodes enclosing the ends of said tube, said electrodes having a very small portion of their internal surface in contact with the external surface of said tube end to provide a spacing between the remaining internal surface of said electrodes and the remaining external surface of the adjacent tube end.

5. In a luminous discharge device comprising a translucent tube with open ends, containing a rarefied gas and provided with electrodes enclosing the ends of said tubing, said electrodes having only two small annular portions of their internal surface in direct contact with said translucent tube and the entire external thereof exposed to the atmosphere, and a heat radiator mounted on the external surface of the said electrodes.

6. In a luminous discharge device comprising a translucent tube with open ends and containing a rarefied gas, a hollow electrode surrounding the open ends of said translucent tube provided with an elongated internal surface in contact with said tube at two small annular portions thereof and sealed externally of said tube at one of said internal annular portions, whereby the electrical discharge of the said device is prevented from originating at the seal of said electrode.

MONTFORD MORRISON.