Feb. 3, 1942. S. C. MILLER 2,271,658

LUMINOUS SIGN ELECTRODE CONSTRUCTION

Filed Dec. 1, 1938 2 Sheets-Sheet 1

Fig. 1.

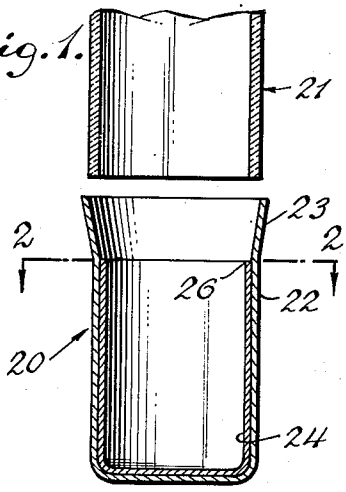


Fig. 2.

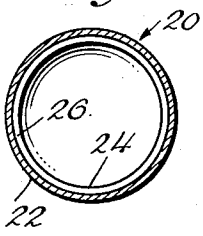


Fig. 3.

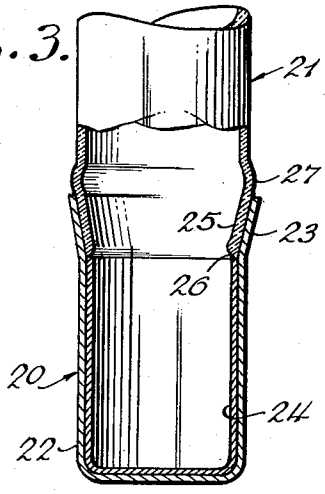


Fig. 4.

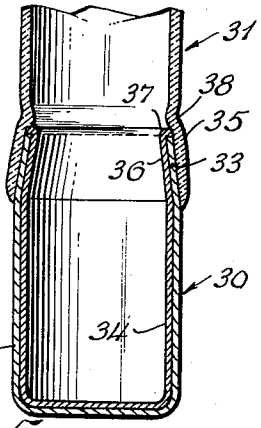


Fig. 8.

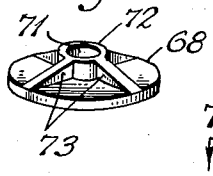


Fig. 6.

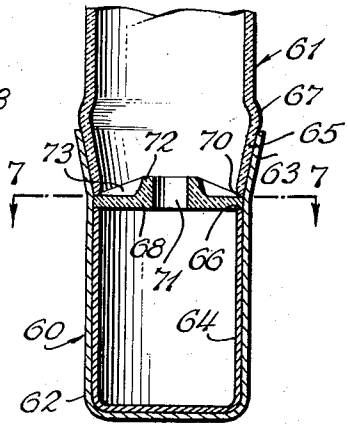


Fig. 9.

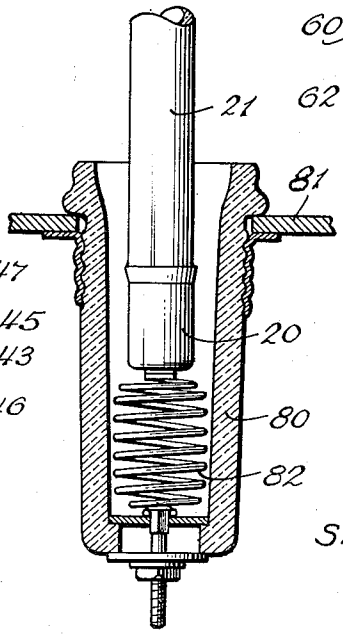


Fig. 5.

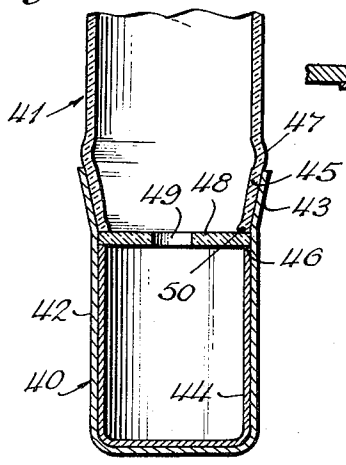
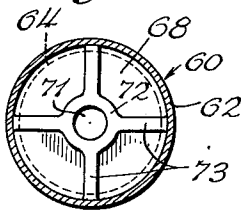


Fig. 7.



INVENTOR.
SAMUEL C. MILLER
J. J. Basseches
his ATTORNEY.

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LUMINOUS SIGN ELECTRODE CONSTRUCTION

Filed Dec. 1, 1938 2 Sheets-Sheet 2

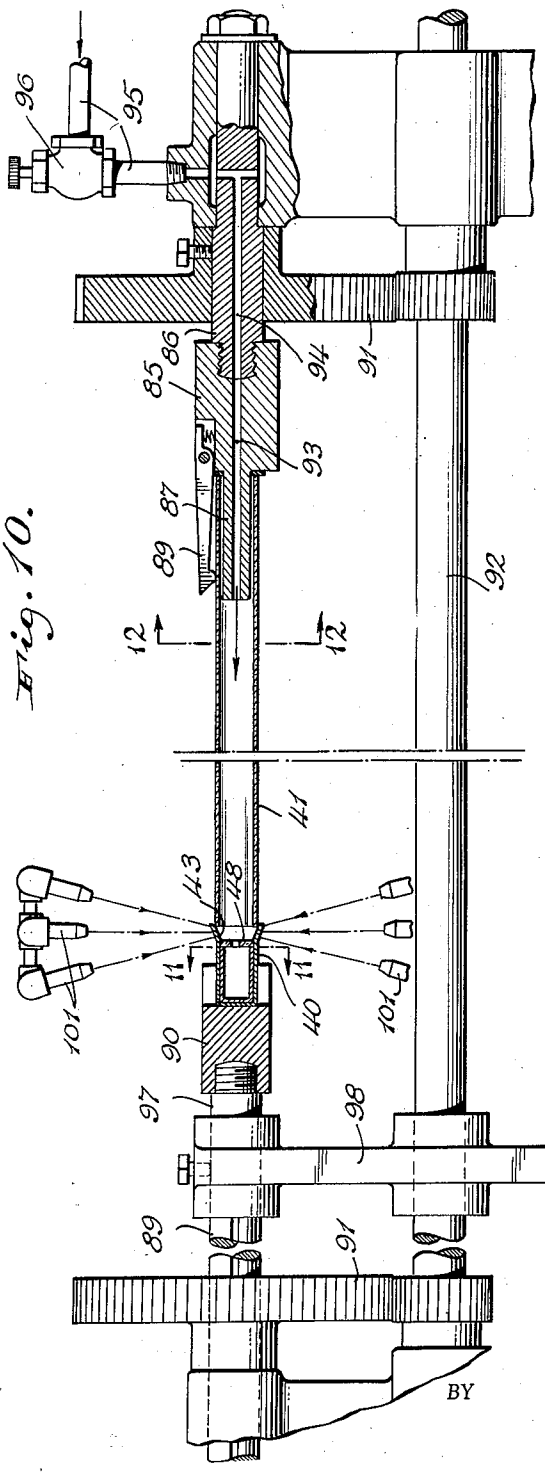


Fig. 10.

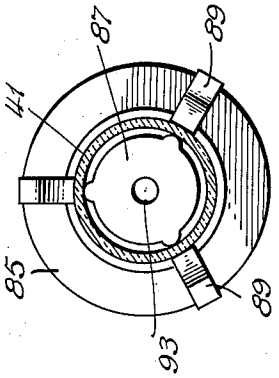


Fig. 12.

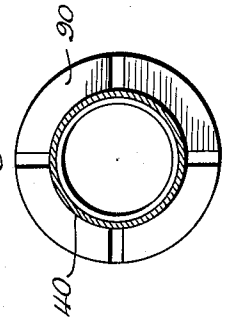


Fig. 11.

INVENTOR.
SAMUEL C. MILLER
BY
J. J. Basseches
his ATTORNEY.

Patented Feb. 3, 1942 2,271,658

UNITED STATES PATENT OFFICE

2,271,658

LUMINOUS SIGN ELECTRODE CONSTRUCTION

Samuel C. Miller, New York, N. Y.

Application December 1, 1938, Serial No. 243,308

10 Claims. (Cl. 176—126)

This invention relates to electrodes; more particularly to electrodes for luminous signs, such as neon tube signs; more particularly to a metal-to-glass sealed electrode employed in luminous tubes depending for their luminescence on the effect of high potential electric currents on an ionizable inert gas filling. Coordinately therewith it relates to a method of making such electrodes.

For the sake of simplicity, I will hereinafter employ the term "neon tube" to designate luminous gaseous discharge tube to designate all tubes of the character mentioned, that is tubes having an inert ionizable gaseous filling that are excited by high potential electrical currents, and it is to be understood that when I employ the term "neon tube" I do not intend to restrict myself to such tubes in which the gaseous filling is neon.

One of the greatest problems met with in the manufacture of neon tubes is the difficulty of sealing the electrodes into the glass of the tube so as to secure a seal that will be leak-proof under conditions of use and will withstand the "bombarding" treatment to which the tubes are subjected during the process of manufacture.

While the well known "Housekeeper" joint provides a leak-proof seal for large electrodes, it is not commercially practical. As a consequence, although large electrodes are preferable, they have not until recently been much used and small electrodes which are more readily sealed have been used in place thereof.

In my copending application S. N. 190,230 filed February 12, 1938, of which this is a continuation-in-part, I have taught the use of specified chromium steel uniformly deep drawn into cup shaped electrodes, specifically referring to Allegheny 55 metal as the material of which electrodes are made, and have also disclosed a construction and a method adapted for the commercial production of large electrodes. As stated in my application aforesaid, the typical analysis for Allegheny 55 is more specifically described in Bulletin 55 Allegheny Steel Co. 1934 and includes from 23 to 30% of chromium with carbon .25%, manganese 1.00%, phosphorus .025%, sulphur .025%, silicon .50% and the balance iron. However, while a leakproof seal may be obtained by following the teachings of my aforementioned copending application, and the electrodes disclosed therein operate satisfactorily in connection with inert carrier gases such as red gas neon tubes, they do not operate properly with glass tubing known as fluorescent tubing or with glass tubing in which in addition to carrier gases, mercury vapor is used. With fluorescent tubing using other than inert gases where electrodes of alloys are used to provide low coefficient of expansion compatible to form glass seals such as Allegheny 55 metal, the tube would darken. This I attribute to the alloying with iron of materials which provide it with the appropriate coefficient of expansion of the nature corresponding to glass, the exact nature of the defect of which is not to be taken as controlling but which practical experience has taught causes failure.

It is therefore among the objects of my invention to provide a commercially practical electrode that may be readily joined to glass in a leak-proof manner and at the same time be capable of satisfactory use with neon tubes containing the inert gases such as helium, neon, argon, xenon, krypton or mixtures thereof as well as with tubes containing gases other than inert vapors or gases, and particularly with fluorescent tubes and with tubes containing the carrier gases together with active gases or vapors, for example, mercury vapor.

A further object of my invention is the provision of an electrode having a portion of its surface that is sealed to the glass of a low coefficient of expansion base metal alloy such as Allegheny 55 metal, while its active electrode surface is of a metal capable of satisfactory use with neon tubes containing inert gases or vapors as well as with tubes containing active gases or vapors, and particularly with fluorescent tubes and with tubes containing mercury vapor.

It is also an object of my invention to provide an improved method of assembling electrodes to glass tubes.

Among the more particular objects of my invention is further the provision of an electrode for neon tubes employing active gases or vapors of low coefficient of expansion alloys amenable to be sealed to glass such as for example of Allegheny 55 metal, with a lining of a metal which is not adversely affected by active vapors or gases such as mercury vapor but of itself incapable of sealing to glass such as for example purified iron, Swedish iron known as Svea metal and other electrode metals found satisfactory heretofore with active gases particularly in the relationship with fluorescent coatings of neon sign tubing.

A further difficulty experienced with neon tubes is that due to the phenomenon of "sputtering," that is a disintegration of the metal of the electrode on the walls of the tube, and which phenomenon is particularly objectionable because

it causes rapid deterioration of the tube by reason of the occlusion of the gases in the tube in the deposited electrode metal.

It is a further object of my invention to provide a cathode in which sputtering is greatly reduced, if not eliminated.

It is a more particular object of my invention to provide in a neon tube means to prevent bombardment of the walls of the tube adjacent the electrode and to centralize it along the length of the tube.

Still more specifically, it is an object of my invention to provide a ceramic collar in adjacency to the electrode of a neon tube, in order to confine the electric discharge into the tube through the opening in the collar.

It is further among the more particular objects of my invention to provide means for preventing contact of mercury contained in a neon tube with the electrode thereof.

It is the general object of my invention to provide a simple, economical and efficient electrode for neon tubes and a simple, economical and efficient method of effecting a seal between an electrode and the glass tubing for a neon sign tube.

To attain these objects and such further objects as may appear herein or be hereinafter pointed out, I make reference to the accompanying drawings, forming a part hereof, in which

Figure 1 is a longitudinal sectional view through one embodiment of my improved electrode construction, together with a sectional view through an end portion of a glass tube adapted to have the electrode applied thereto;

Figure 2 is a transverse sectional view through the electrode of Figure 1 taken substantially on the line 2—2 of Figure 1, looking in the direction of the arrows;

Figure 3 is a view partly in section, showing the electrode of Figure 1 sealed in place on the glass tube portion of Figure 1;

Figure 4 is a view similar to Figure 3 but showing a modified form of electrode;

Figure 5 is a view similar to Figure 3 showing an electrode including a ceramic collar;

Figure 6 is a view similar to Figure 5 showing a modified form of ceramic collar;

Figure 7 is a sectional view on the line 7—7 of Figure 6, looking in the direction of the arrows;

Figure 8 is a view in perspective of the ceramic collar of Figures 6 and 7;

Figure 9 is a fragmentary longitudinal sectional view through an electrode insulator housing showing a luminous gaseous discharge tube provided with an electrode of the type shown in Figures 1, 5 or 6 assembled in place therein;

Figure 10 is a fragmentary elevational view, partly in section, illustrating apparatus for performing the process of sealing my improved electrode in place on a glass tube, and also indicating the steps of the process;

Figure 11 is a sectional view on the line 11—11 of Figure 10 looking in the direction of the arrows;

Figure 12 is a section on the line 12—12 of Figure 10 looking in the direction of the arrows.

Reference will now be made to Figures 1, 2 and 3 for a detailed disclosure of an illustrative embodiment of my improved electrode construction.

In these figures the numeral 20 designates the electrode as a whole, and the numeral 21 designates an end portion of the glass tube of a luminous gaseous discharge tube, such as a neon tube. In Figure 1 these are shown prior to assembly, while in Figure 3 the electrode 20 is shown sealed in place on the tube 21.

The electrode 20 is shown as comprising an outer cylindrical cup or shell 22 of relatively great axial extent provided with an outwardly flaring mouth portion 23, and an inner sleeve or lining 24 fitting tightly thereinto and terminating short of the aforesaid mouth portion 23.

The sleeve 22 is made of Allegheny 55 metal which is a chrome steel alloy of the heat resisting stainless steel group, and the desirable characteristics of which for the purpose intended have been fully discussed in my aforesaid copending application. Briefly, they may be summarized as resistance to heat, resistance to oxidation, the property of being readily wetted by fused glass at the temperatures necessary for working the glass customarily employed for neon tubes, and sufficient resistance to deformation at the temperatures to which it is subjected during the process of bombardment.

However, while this metal is satisfactory for a neon tube electrode, even to the extent of forming the active electrode surface thereof, where red gases are used, I have, as already stated, found that where fluorescent tubing is used, or where the tube contains mercury vapor, the tube will darken. In order to overcome this, while at the same time retaining the metal to glass bonding characteristics of my electrode, I make the active electrode surface of a substance that will have the desired characteristics, while using Allegheny 55 metal or its equivalent as a carrier therefor. In the illustrative embodiment of my invention disclosed in Figures 1, 2 and 3, this is accomplished by making the inner lining 24 of Svea metal, which is a purified iron or Swedish iron. Other lining metals found by experience to be suitable in the presence of active gases or vapors though not suitable for a metal to glass seal may be employed.

This lining 24 is preferably forced into the outer shell 22 with a driving fit.

The end of the tube 21 is adapted to seat within the mouth portion 23 of the electrode, and during the sealing operation, which will be described hereinafter in connection with Figures 10, 11 and 12, its end portion assumes the contour shown in Figure 3, from which it appears that the tapered end 25 of the tube 21 extends into contact with the end 26 of the Svea metal lining 24, so that the entire active surface of the electrode consists of the lining metal. A slight bulge, 27, in the walls of the glass tube is also shown; this usually results from the method employed for the sealing operation, as will appear hereinafter.

Attention may here be called to the centering effect of the mouth portion 23 on the glass tube, whereby on relative axial movement of the electrode and the tube, the latter will automatically tend to align itself axially with the electrode.

In the form of electrode shown in Figure 4 I attain the same result in a different manner. in this figure the electrode is designated in general by the numeral 33 and the glass tube by the numeral 31.

The electrode 30 is shown as comprising an outer cup or shell 32 of low coefficient of expansion metal sealable directly to glass such as Allegheny 55 metal having a tapered end portion 33. The Svea metal lining 34 follows the contours of the outer shell 32 within which it seats, and its tapering end portion 36 is provided with an outwardly turned flange 37 that

overlies the extreme end of the tapered portion 33 of the outer Allegheny metal shell.

The glass tube 31, when it assumes its final position, with the electrode sealed in place thereon, comprises an outwardly flaring mouth portion 35, the inner surface of which is fused to the outer surface of the tapered portion 33 of the electrode, and is further shown as engaging the rib 37 of the Svea metal lining, so that the surface of the Allegheny 55 metal lining is at no point exposed to the gases within the tube. An inward bulge 38 in the walls of the glass tube that slightly overlies the flange 37 further assures this result.

In order to prevent bombardment of the walls of the electrode adjacent the seal between the cup shape electrode and glass, I may provide means to centralize the electric discharge along the longitudinal axis of the tube. Such means are shown in Figure 5 applied to an electrode of the type shown in Figure 3.

The numeral 40 in Figure 5 designates generally the electrode and the numeral 41 the glass tube to which it is sealed. The outer Allegheny metal shell 42 of the electrode is provided with an inner lining 44, on the end 26 which seats a collar 48 of a material adapted to intercept the electric discharge from the electrode, the passage of which is thereby confined to the opening 49 centrally positioned in the collar 48. I have found ceramic materials, such as porcelain, a suitable substance for the collar 48. The tapered end portion 45 of the glass tube 41 seats within the outwardly flaring mouth portion 43 of the Allegheny metal shell 42 and is sealed thereto while its extreme end portion 50 is also sealed to the collar 48. As before, the Allegheny metal is kept out of contact with the gases with which the tube is filled.

In the form of Figures 6, 7 and 8, which also includes a ceramic collar, the electrode construction of Figure 5 is used, but the ceramic collar has a flange thereon surrounding its central opening and extending outwardly from the collar in a direction away from the electrode, whereby globules of mercury collecting in the tube and running along the walls thereof and the wall of the collar, will be prevented from running into the electrode and affecting the surface thereof.

In these figures 60 designates the electrode, 61 the glass tube and 68 the ceramic collar. The electrode 60 like the electrode 40 of Figure 5 is provided with an outer Allegheny 55 metal shell 62 provided with an outwardly flaring mouth portion 63, and an inner lining of Svea metal, the end portion 66 of which abuts against the collar 68. The glass tube 61, like the tube 41 of Figure 5, is shown as having a tapered end portion 65 seating within and sealed to the mouth portion 63 of the electrode and also sealed to the collar 68 at its extreme end portion 70.

The collar 68 is shown provided with a flange 72 surrounding the restricted opening 71 therein, and extending outwardly from the electrode and into the tube, and having the desired function of preventing the entrance of metallic mercury into the electrode chamber. Means may also be provided for the purpose of strengthening or bracing the collar and its flange. Such means is shown in the form of ribs 73 extending outwardly from the flange 72.

In Figure 9 I have illustrated the manner of installing a neon tube provided with electrodes of the type herein disclosed, and which electrode, by way of example, has been shown as the form of Figure 1. The mounting shown is of the type more specifically described and illustrated in my Patent No. 2,046,960; July 7, 1936.

It will be observed that an electrode housing insulator 80 is shown as mounted on the sign frame 81. A contact spring 82 is mounted within the housing 80 and presses against the electrode 20 sealed to the end of the tube 21. The many advantages of this efficient and compact mounting need not be amplified upon here, since they will be found fully set forth in the aforementioned patent. In addition, it may be noted that my cup shaped electrode provides great compactness with appropriate electrode surface not attainable by a lead-in-sealed electrode.

The method phase of my invention will now be explained with the aid of Figures 10, 11 and 12 in reference to sealing a glass tube into an electrode of the form shown in Figure 5.

In these figures the glass tube is shown at 41 and the electrode at 40. The former is shown as mounted on a spindle of one of the stocks of a glass blower's lathe of a conventional type adapted to carry out the desired operation, and the electrode is mounted on the spindle of the other stock. For holding the glass tube 41 I have shown a chuck 85 mounted on the right spindle 86 of the lathe and provided with a mandrel 87 extending into the bore of the tube 41, and jaws 88 pressing against the outer walls of the tube.

The electrode 41 may be mounted on the other spindle 89 in any suitable or preferred manner, as by clamping in the chuck 90.

The spindles 86 and 89 are shown as rotatable similarly by means of suitable gearing indicated at 91, which is actuated from a common source of power, such as the rotating shaft 92.

Air under pressure may be admitted to the inside of the tube 41, while it is rotating by means of a central duct 93 in the chuck 85, that communicates with a duct 94 in the spindle, the latter being in communication through pipes 95 and a valve 96 with a source of compressed air.

The mounting of the chuck 90 is such that it may move axially on the spindle 89, for which purpose it is shown carried on a head 97 slidable on the spindle 89 but rotatable therewith, and movable axially by an arrangement comprising a member 98 shown as movable in an axial direction by an arrangement comprising a rack 99 and a pinion 100.

Batteries of blow pipes 101 are shown so positioned that they concentrate their flames on the point at which the seal is to be effected. Two such batteries of blowpipes are shown; while they are shown in the drawings as operating in a vertical plane, it is to be remarked that they are preferably positioned so as to operate in a horizontal plane.

In carrying out my improved process the electrode 40 is mounted in the chuck 90 and the tube 41 in the chuck 85, and the chuck 90 is then moved by means of the rack and pinion arrangement 99, 100 until they assume the position of Figure 10. The blow pipes 101 are then played on the exterior of the mouth portion 43 of the electrode, while at the same time the lathe is rotated and axial pressure is maintained on the electrode by the aforementioned rack and pinion adjustment. At the same time air pressure is maintained within the tube 41 by the air pressure system heretofore described.

When the requisite temperature has been reached the glass of the tube 41 becomes plastic,

and, as a result of the axial pressure on the electrode, it is deformed and gradually enters the flaring mouth 43 of the electrode. The air pressure within the tube 41 assures proper contact between the outer walls of the tube and the inner walls of the mouth 43, so that, when the blow pipes have raised the temperatures of the mouth 43 and the end of the glass tube sufficiently the fused glass wets the inner walls of the mouth 43 and effects the sealing. Thereafter the heating is either discontinued, where annealing may be dispensed with, or it is gradually reduced in order to effect proper annealing. It will be observed that as the glass seats itself in the electrode there is a wiping action that tends to effect proper wetting of the electrode surface, and to dislodge any impurities thereon that might interfere with the proper formation of a lap joint between the glass tube and the electrode. Simultaneously with the formation of this lap joint, a butt joint is formed between the end of the glass tube and the ceramic collar 48.

It will further be noted that the blow torches play primarily on the metal of the electrode and not exclusively on the glass, which, where it is underneath the metal, thereby receives its heat through the wall of the metal. Consequently the former is more intensely heated than the latter, which is of advantage in securing a good seal, since the metal can be heated to a higher temperature without deformation, than can the glass. This procedure also serves to have the electrode support the glass as it reaches plasticity.

It is to be understood that where the other forms of electrodes herein disclosed are used, that the process outlined herein for the form of Figure 5 will be modified as needed to suit the particular requirements.

It will thus be observed that I have provided an improved electrode of novel and simple construction adapted for use with neon tubes employing red gases or gases other than red gases, and in particular fluorescent tubes and tubes containing mercury, an electrode that can be readily and securely sealed to a glass tube, and an electrode in which sputtering is reduced.

It will further be observed that I have provided an improved process for readily and effectively performing the operation of sealing the electrode and the glass of a tube together.

While I have specifically exemplified as the metal for forming the outer shell as made of Allegheny metal No. 55 as specifically described in my copending application aforesaid, it will be understood that any base metal alloy electrode may be utilized which has the desired compatibility for fusion to glass and the necessary coefficient of expansion but which may be deleterious in its action in the presence of an active gas such as mercury vapor particularly where fluorescent coatings are applied to the glass tubing.

It will also be observed that while I have specifically exemplified purified iron or Svea metal as the liner metals which may be used and which are not deleterious in the presence of active vapors such as mercury vapor particularly, it will be understood that those metals which may be used in the presence of mercury vapor and fluorescent coatings on glass tubings of neon signs or similar illuminating units, may also be used, from experience gained in using electrodes housed within the glass and sealed by a lead-in-wire connected with the shell electrode.

Therefore my invention it will be understood, has broader application than merely involving the use of Allegheny 55 metal and a liner of purified iron such as Svea metal but that it resides in the combination in a thimble or cup shaped electrode of a low coefficient of expansion metal which is sealable to glass which may be uniformly drawn to sustain the temperatures involved in glass to metal sealing operations, with a liner of electrode metal inert or non deleterious in the presence of active gases or vapors such as mercury vapor where particularly fluorescent coatings are used in the illuminating glass tubing, and that the scope of the invention is to be judged by the appended claims.

Having thus described my invention and illustrated its use, what I desire to secure by Letters Patent is:

1. An electrode for a fluorescent neon tube comprising a substantially uniformly drawn shell having a mouth portion defined by angularly directed walls for forming on one surface of said walls a lap joint for a glass-to-metal seal, said shell being made of a metal whose coefficient of expansion is such that it is readily bonded to glass by a lap joint sealing operation, and a liner on the interior of said shell made of a material adapted to serve as the active electrode surface of a neon tube and not deleteriously affecting the fluorescent material embodied in said tube in the presence of active gases or vapors employed to induce a fluorescent effect in operation of said tube, said liner extending in the direction of the walls of said angularly formed mouth portions whereby completion of the seal at the said walls of said mouth portion will also complete a seal below said mouth portion to protect the fluorescent tube from the deleterious effect of the metal of said shell.

2. An electrode for a fluorescent neon tube comprising a substantially uniformly drawn shell having a mouth portion defined by angularly directed outwardly flared walls for forming on one interior surface of said walls a lap joint for a glass-to-metal seal, said shell being made of a metal whose coefficient of expansion is such that it is readily bonded to glass by a lap joint sealing operation, and a liner on the interior of said shell made of a material adapted to serve as the active electrode surface of a neon tube and not deleteriously affecting the fluorescent material embodied in said tube in the presence of active gases or vapors employed to induce a fluorescent effect in operation of said tube, said liner extending in the direction of the flared portions of the walls of said angularly formed mouth portions whereby completion of the seal at the said walls of said mouth portion will also complete a seal below said mouth portion to protect the fluorescent tube from the deleterious effect of the metal of said shell.

3. An electrode for a fluorescent neon tube comprising a substantially uniformly drawn shell having a mouth portion defined by angularly directed walls for forming on one surface of said walls a lap joint for a glass-to-metal seal, said shell being made of a metal whose coefficient of expansion is such that it is readily bonded to glass by a lap joint sealing operation, and a liner on the interior of said shell made of a material adapted to serve as the active electrode surface of a neon tube and not deleteriously affecting the fluorescent material embodied in said tube in the presence of active gases or vapors employed to induce a fluorescent effect in operation of said tube, said liner extending in the direction

of the walls of said angularly formed mouth portions whereby completion of the seal at the said walls of said mouth portion will also complete a seal with respect to the said liner to protect the fluorescent tube from the deleterious effect of the metal of said shell.

4. An electrode for a fluorescent neon tube comprising a substantially uniformly drawn shell having a mouth portion defined by angularly directed outwardly flared walls for forming on one interior surface of said walls a lap joint for a glass-to-metal seal, said shell being made of a metal whose coefficient of expansion is such that it is readily bonded to glass by a lap joint sealing operation, and a liner on the interior of said shell made of a material adapted to serve as the active electrode surface of a neon tube and not deleteriously affecting the fluorescent material embodied in said tube in the presence of active gases or vapors employed to induce a fluorescent effect in operation of said tube, said liner extending in the direction of the flared portions of the walls of said angularly formed mouth portions whereby completion of the seal at the said walls of said mouth portion will also complete a seal in respect of the said liner to protect the fluorescent tube from the deleterious effect of the metal of said shell.

5. An electrode in accordance with claim 4 wherein the metal of said shell comprises a chromium steel.

6. An electrode in accordance with claim 4 wherein the said liner comprises a purified iron electrode metal.

7. An electrode in acordance with claim 1 wherein a vitreous disc formed with an orifice is interposed adjacent the mouth of said shell and in which a portion of said liner forms an abutment for said disc.

8. An electrode in acordance with claim 2 wherein a ceramic disc formed with an orifice is interposed adjacent the mouth of said shell and in which a portion of said liner forms an abutment for said disc, with the disc sealed between the edges of the glass and the abuting portion of said liner.

9. An electrode in accordance with claim 1 wherein a ceramic disc formed with an orifice defined by an upwardly directed flange is interposed adjacent the mouth of said shell and in which a portion of said liner forms an abutment for said disc, and in which the flange provides a trap or well for condensed vaporous material.

10. An electrode in accordance with claim 2 wherein a ceramic disc formed with a central orifice defined by an upwardly directed flange is interposed adjacent the mouth of said shell and abutting an edge portion of said liner with the edge of said tube sealing said disc in the abutting position.

SAMUEL C. MILLER.