

Aug. 28, 1934.

W. J. WINNINGHOFF

1,971,945

GASEOUS ELECTRIC DISCHARGE DEVICE

Filed Jan. 26, 1931

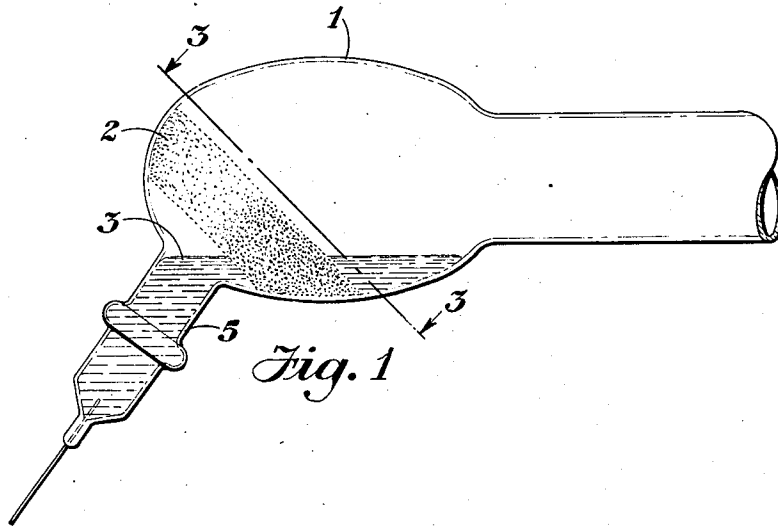


Fig. 1

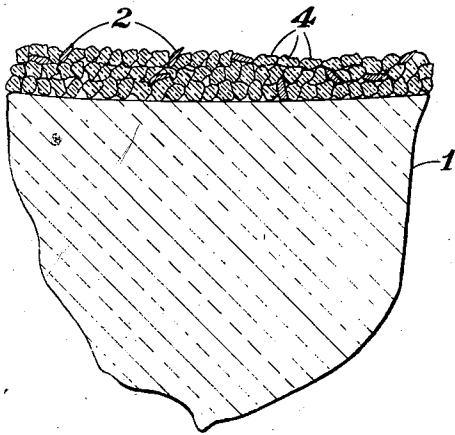


Fig. 2

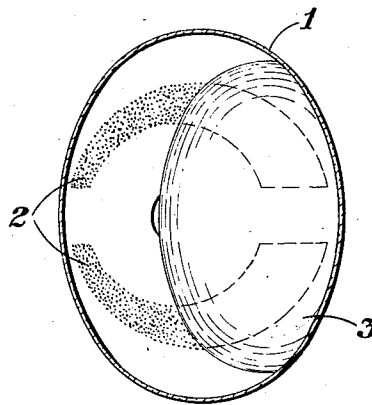


Fig. 3

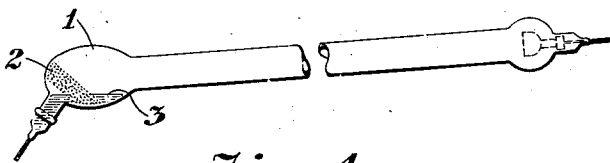


Fig. 4

INVENTOR

Wilford J. Winninghoff

BY

*W. D. Brown*

ATTORNEY

# UNITED STATES PATENT OFFICE

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## GASEOUS ELECTRIC DISCHARGE DEVICE

Wilford J. Winninghoff, South Orange, N. J., assignor to General Electric Vapor Lamp Company, Hoboken, N. J., a corporation of New Jersey

Application January 26, 1931, Serial No. 511,410

3 Claims. (Cl. 176-42)

The present invention relates to electrical discharge devices, and more particularly to vapor arc devices. A particular object of the invention is to provide a vapor arc device in which the discharge may be easily initiated. Another object of the invention is to provide a device having a long useful life. Other objects and advantages of my invention will appear from the following particular description of my novel device, or from an inspection of the accompanying drawing.

The invention consists in a new and novel device as hereinafter set forth and claimed.

In starting low voltage vapor arc devices, such as the well known Cooper Hewitt mercury vapor arc lamp, it is customary to impress a high voltage surge upon the mercury cathode to depress its electrostatic potential to the point where electrons are drawn out of the mercury pool into the adjacent space, these electrons ionizing by collision the mercury particles with which they come in contact while passing through the attenuated mercury vapor in the device. This ionization, as is well known, allows a disruptive discharge to take place from the cathode to an anode whereby the arc path is made conductive, permitting the main discharge to start. Commercial experience has shown that the convex meniscus which is characteristic of mercury in contact with glass makes it relatively difficult to produce the aforesaid disruptive discharge, hence a number of attempts have been made heretofore to modify the natural mercury meniscus in order to facilitate the initiation of a discharge in such devices. All of the expedients heretofore tried have had some objectionable feature, however, in that some were relatively ineffective, while others adversely affected the useful life of the device. Some better method of modifying the mercury meniscus has, therefore, been actively sought. I have now discovered that if a metal with which mercury will amalgamate, such as aluminum, copper or the like, is finely divided and embedded in the wall of the cathode bulb in such a position as to be in contact with the mercury meniscus, the mercury soon amalgamates with any exposed portion of said metal particles, especially after the surface of these particles has been cleaned by the arc, providing a surface to which the mercury readily adheres. At the same time the embedded metal is so confined that it is not readily dissolved to any extent by the mercury, with the result that the mercury cathode is not appreciably contaminated thereby. The thin oxide film which quickly forms on such metals as copper and aluminum when exposed to the air, and which is thus pres-

ent on the particles introduced into the device, likewise tends to prevent amalgamation, and thereby materially aids in keeping the mercury in a desired condition of purity. The concave meniscus resulting from this wetting of the embedded metal causes the electrostatic field to be strongly concentrated at the edges of the mercury cathode, greatly facilitating the production of a disruptive discharge therefrom. As a result a discharge can be very easily started in my new discharge device. It has, in fact, been found that the probability of the arc being initiated upon the first application of a voltage surge to the cathode of a device constructed according to my new invention is at least several times greater than it is when devices of the prior art are used.

Moreover, my new discharge device has been found to have a useful life which compares favorably with that of the best devices heretofore produced. This new construction therefore permits attainment of the desired result without introducing any of the objectionable features heretofore attendant upon changes of the mercury meniscus.

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

Fig. 1 is an elevational view of the cathode bulb of a mercury vapor arc lamp of the Cooper Hewitt type, with the usual starting band on the outside of the cathode bulb removed to show the metallic particles which are embedded in the wall thereof,

Fig. 2 is a sectional view of a fragment of said cathode bulb, greatly magnified to show a preferred manner of embedding the metallic particles in the surface thereof,

Fig. 3 is a sectional view of the cathode bulb taken on the line 3-3 of Fig. 1, showing the distribution of the metallic particles within the bulb, and

Fig. 4 is an elevational view of a lamp which has been constructed according to my invention, as it appears before the conventional starting band is placed on the outside of the cathode bulb.

In this drawing the cathode bulb 1 of a mercury vapor arc lamp of the well known Cooper Hewitt type is shown as having a number of small particles 2 of a metal with which mercury will amalgamate, such as aluminum, copper, or the like, partially embedded in the interior thereof in such a position as to be in contact with the meniscus of the mercury cathode 3 when said lamp is in an operating position, such as shown in Fig. 4. These metallic particles 2 may be

embedded in the vitreous wall of the cathode bulb 1 in any suitable manner, as by the well known method of heating said cathode bulb until it is sufficiently softened to permit said particles to sink into the surface thereof. I prefer, however, to first mix the metallic powder 2 with finely powdered glass 4, this mixture then being fritted or fused to the inner wall of the bulb 1, as shown in Fig. 2, since a more even distribution of the metallic particles can be attained thereby. Only a small amount of powdered metal is necessary or desirable for this purpose, one gram of aluminum powder to 200 grams of powdered glass being found to give good results. I prefer to use for the powdered glass 4 a glass having a lower melting point than that of the vitreous material used for the cathode bulb 1, since distortion of the bulb 1 during the fritting process is thereby eliminated. Where the cathode bulb consists of lead glass, for instance, I find a glass such as the French seal glass manufactured by Corning Glass Works, Corning, New York, U. S. A., and known to the trade as G858V to be entirely satisfactory. This glass, which consists of 55-60% alkali (NaO or K<sub>2</sub>O) and 35-37% SiO<sub>2</sub>, not only has a fusing temperature materially below that of lead glass, but also has substantially the same coefficient of expansion as lead glass, so that the possibility of strains is greatly minimized. The mixture of powdered glass 4 and metal powder 2 is most conveniently fritted or fused to the wall of the bulb 1 by a novel process of my invention which is fully disclosed in my application, Serial No. 511,409, filed concurrently herewith, for a "Method of affixing foreign substances to a vitreous body". According to this method I agitate the aforesaid mixture with a sufficient quantity of a volatile fluid, such as ethyl alcohol, to produce a semi-fluid mass, flow said mass over the desired surfaces of the bulb 1, allow it to dry, and then, after wiping off any undesired portions thereof, apply sufficient heat to frit the mass to said cathode bulb. The metallic particles 2 are preferably confined to such an area of the cathode bulb 1 that the mercury meniscus crosses the edge thereof several times, since it has been found that the points at which the mercury meniscus changes from the convex to the concave are the most effective in initiating a discharge. In a preferred arrangement, as shown in Fig. 3, the metallic particles are embedded in a ring-shaped area about the negative inlead chamber 5, the ring being broken in two places, whereby the mercury meniscus crosses the edge of the area in which the metallic particles are embedded four times in any possible operating position of the lamp.

In the use and operation of my new lamp the mercury cathode 3 amalgamates with any exposed portion of the metallic particles 2, producing a surface which said cathode wets. The resulting concave meniscus greatly facilitates the starting of the arc, since the electrostatic stress which is impressed upon the cathode 3 according to the conventional method of starting the lamp is concentrated in the upturned edge, increasing the field strength so that a relatively large num-

ber of electrons are drawn therefrom into the adjacent vapor, these electrodes promoting the formation of the disruptive discharge therefrom by means of which the main arc is initiated. Due to the fact that only a relatively small portion of the surface of the metallic particles is exposed these particles are not dissolved to any extent by the mercury, so that the purity of the mercury is not appreciably affected, as it has been by some of the prior attempts to change the mercury meniscus, hence the life of the device is not adversely affected. The metals which readily oxidize on the surface in air, such as aluminum or copper, are particularly advantageous for use in my new lamp, since the oxide film very effectively prevents any amalgamation thereof, except at the surface of the mercury, where the particles are in contact with the arc. An inspection of lamps having aluminum, for instance, embedded in the cathode bulb shows that even after considerable operation thereof there is no amalgamation between the metallic particles and the mercury, save at the meniscus where the arc has had an opportunity to clean the metal particles, either by reduction of the oxide or by the knocking off of the oxide. As a result I am able to produce a maximum effect on the meniscus with a minimum of contamination of the mercury by using these metals in a mercury arc lamp. This effect is greatest with aluminum, which is the metal I prefer to use in my lamps, since it appears to give the most satisfactory results.

While I have described my new invention by reference to a specific structure it is to be understood that it is not limited thereto, but that various substitutions, omissions and changes, within the scope of the appended claims, may be made therein without departing from the spirit of my invention.

I claim as my invention:

1. A mercury vapor arc device comprising a sealed vitreous envelope, an anode, a mercury cathode, and means to alter the meniscus of said cathode comprising particles of a readily oxidizable amalgam forming metal partially embedded in the wall of said envelope in contact with said meniscus.

2. A mercury vapor arc device comprising a sealed vitreous envelope, an anode, a mercury cathode, and means to alter the meniscus of said cathode comprising particles of aluminum embedded in the wall of said envelope in contact with said meniscus.

3. A mercury vapor arc device comprising a sealed vitreous envelope, an anode, a mercury cathode, and means to alter the meniscus of said cathode comprising particles of metal partially embedded in the wall of said envelope in contact with said meniscus when said lamp is in an operating position, and more particles of a like nature partially embedded in the wall of other parts of said envelope with which said meniscus may come in contact at other operating positions of said lamp, the latter particles having a film of oxide thereon.

WILFORD J. WINNINGHOFF.

**Certificate of Correction**

**3**

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**WILFORD J. WINNINGHOFF**

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 25, before "alkali" insert the symbols  $PbO_5-8\%$ ; and in the same line for " $N_2O$ " read  $Na_2O$ ; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 6th day of November, A. D. 1934.

[SEAL]

**LESLIE FRAZER,**  
*Acting Commissioner of Patents*