May 10, 1932. A. J. McMASTER ET AL 1,858,210

ELECTRONIC TUBE

Filed July 7, 1930

Fig. 1

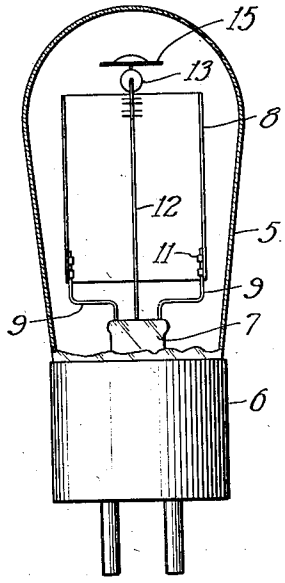


Fig. 3

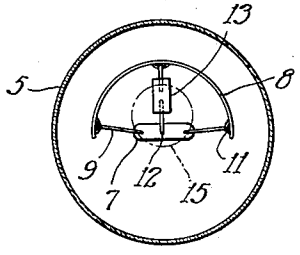
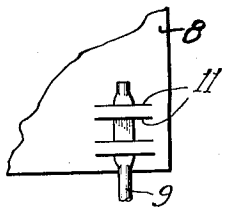


Fig. 2



Inventors
Archie J. McMaster
Charles E. Parson
By George E. Mueller Atty.

Patented May 10, 1932 1,858,210

UNITED STATES PATENT OFFICE

ARCHIE J. McMASTER AND CHARLES E. PARSON, OF CHICAGO, ILLINOIS, ASSIGNORS TO G-M LABORATORIES, INC., OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

ELECTRONIC TUBE

Application filed July 7, 1930. Serial No. 466,107.

Our invention relates to electronic tubes and more particularly to the cathode or electron emitters of photoelectric tubes.

The surface of the cathode of a photoelectric tube must be prepared with extreme care in order to insure a high degree of light sensitivity. It sometimes happens that apparently uniform methods do not produce uniform results and therefore it was necessary to minutely analyze every detail of the procedure to determine the steps necessary to produce good results.

It has been found that by treating the cathode in the manner to be described highly satisfactory results are obtained.

An object of the invention is to provide a new and improved method of producing a light sensitive cathode for photoelectric tubes.

A further object is to provide a method for securing supports to the cathode plate.

Other objects and advantages will appear as the description proceeds.

Referring to the drawings:

Fig. 1 illustrates a tube made in accordance with the method of our invention, and illustrating certain mechanical features of the invention,

Fig. 2 is a fragmentary detail view showing the manner of securing the cathode plate to the supports, and,

Fig. 3 is a plan view of the tube shown in Fig. 1.

An envelope 5 is mounted on a suitable base 6, and within the envelope is a stem or press 7 upon which the electrodes or elements of the tube are mounted. A semicylindrical cathode plate 8 is mounted upon suitable supports 9.

It is advantageous to make the plate 8 of highly conductive material such as copper, silver, or the like, and due to the high conductivity of this material it is difficult to weld supports such as 9 thereto. We have found that the plate may be securedly mounted on the electrodes by cutting longitudinal lines 11 in the plate and bending the material between two adjacent lines out of the plane of the plate. The support is inserted under these bent portions and in order to prevent rotation of the support it is slightly flattened before insertion. After the supports are inserted the bent out portions are compressed against the support to securely clamp the support and rigidly mount the plate thereon. The pressing of the bent portions of the plate may take place simultaneously with the forming of the plate into semi-circular form.

Forwardly of the cathode is an anode 12 mounted on stem 7, and having its upper end secured to the cathode plate through an insulating connector 13.

Simultaneously with the mounting of the electrode elements in the envelope a pellet 15 consisting of an alkali metal salt such as a cæsium salt and another compound, having a higher affinity for the cæsium salt radical than cæsium, is mounted therein. The pellet may be inductively heated to liberate metallic cæsium.

Cathode plate 8 is preferably made of copper or other highly conductive material as pointed out above, and is provided with a silver oxide coating which may be formed by oxidizing a previously applied silver coating within the envelope or by applying a silver oxide together with a binder such as nitrocellulose, glycerine, or a soluble salt of silver before the cathode is mounted in the envelope.

By the application of heat and exhaustion of the tube the binder may be removed, leaving silver oxide on the surface of the cathode. By whatever method the silver oxide is originally applied it appears to be lacking in the characteristics essential for the most efficient operation of the tube. In order to overcome this difficulty the silver oxide on the cathode is reduced by inductively heating the cathode from 300 to 350 degrees C. causing the liberation of the oxygen from the silver oxide, and leaving a spongy, porous layer of silver on the plate.

The plate is then allowed to cool and an atmosphere of oxygen or an inert gas containing oxygen is introduced into the envelope, and the cathode is heated to cause a re-oxidation of the silver layer. The physical character of this layer appears to enhance re-oxidation and produce improved results in the finished cathode although there may also

be chemical factors which account for the improved results. It is found that the reoxidation of the silver layer thus formed takes place more readily and more uniformly than the first oxidation, producing a base having the desired characteristics for the application of a light sensitive film.

The first oxidation of the silver necessitates the presence of a small quantity of moisture which acts as a catalyst to accelerate the reaction. The introduction of moisture into the envelope however is undesirable on account of the difficulty of removing it after the oxide is formed. The method of painting the plate with a silver oxide before mounting the plate in the envelope permits a dry oxidation of the silver layer after the reduction of the oxide coating.

The light sensitive film is formed by exhausting the envelope and liberating a small quantity of an alkali metal such as cæsium from the pellet mounted within the envelope as described more fully in our copending application, Serial No. 461,117, filed June 14, 1930. The cæsium or other alkali metal is deposited upon the cathode and some of the cæsium reacts with the silver oxide, forming cæsium oxide, which is mutually soluble with metallic caesium. During this process the tube is heated and exhausted to expel any excess of the metallic cæsium, leaving an adsorbed film of cæsium on the surface of the cathode.

The tube may then be sealed off and is ready for use, or an inert gas such as argon may be introduced to increase the sensitivity of the tube as is well known in the art.

What we claim as new and desire to secure by United States Letters Patent is:—

1. A method of producing a light sensitive electron emissive surface which consists of applying a silver oxide coating to a metallic plate, heating said plate to reduce the silver oxide, placing an atmosphere containing oxygen around the plate and reoxidizing the plate, and subsequently forming a light sensitive surface on the plate.

2. A method of producing a cathode for a photoelectric tube which consists of forming a silver oxide coating on a cathode plate, heating the plate to reduce the silver oxide, cooling the plate, reoxidizing the plate, and forming a light sensitive electron emissive surface on the plate.

3. A method of producing a cathode for a light sensitive tube which consists of providing a silver oxide coating on the cathode, reducing said silver oxide, reoxidizing the remaining silver coating, depositing a film of alkali metal on said reoxidized coating, and removing the excess of said alkali metal therefrom.

4. A method of producing a cathode for a light sensitive tube which consists of applying a coating consisting of a silver oxide and a binder to a cathode plate, heating the plate to remove the binder and reduce the silver oxide, cooling the plate, supplying oxygen to the plate, oxidizing said plate, and applying coating of an alkali metal to the plate to form a light sensitive surface.

In witness whereof, we hereunto subscribe our names this 18th day of June, 1930.

ARCHIE J. McMASTER.
CHARLES E. PARSON.