A. McL. NICOLSON & E. C. HULL.

ELECTRON EMITTING CATHODE AND THE PROCESS OF MANUFACTURING THE SAME.

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Fig. 1.

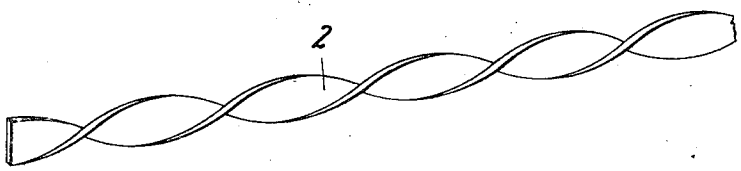
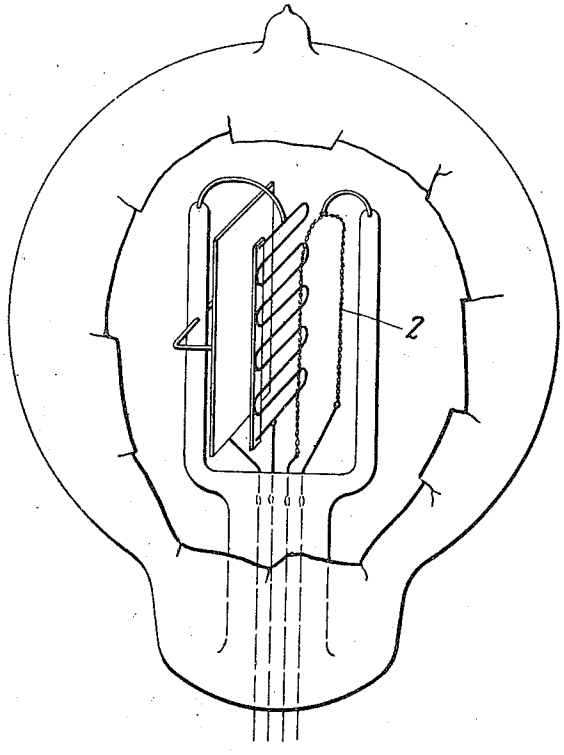


Fig. 2.



Inventors:
Alexander M. Nicolson,
Emerson C. Hull.
by J. L. Roberts
Atty

UNITED STATES PATENT OFFICE.

ALEXANDER McLEAN NICOLSON, OF NEW YORK, N. Y., AND EMERSON CHURCH HULL, OF MONTCLAIR, NEW JERSEY, ASSIGNORS, BY MESNE ASSIGNMENTS, TO WESTERN ELECTRIC COMPANY, INCORPORATED, A CORPORATION OF NEW YORK.

ELECTRON-EMITTING CATHODE AND THE PROCESS OF MANUFACTURING THE SAME.

1,209,324. Specification of Letters Patent. Patented Dec. 19, 1916.

Application filed December 26, 1914. Serial No. 879,208.

To all whom it may concern:

Be it known that we, ALEXANDER McLEAN NICOLSON, a subject of the King of Great Britain, and EMERSON CHURCH HULL, a citizen of the United States, residing at New York, in the county of New York and State of New York, and at Montclair, in the county of Essex and State of New Jersey, respectively, have invented certain new and useful Improvements in Electron-Emitting Cathodes and the Process of Manufacturing the Same, of which the following is a full, clear, concise, and exact description.

This invention relates to electron-emitting cathodes, such as are used in audions or vacuum tubes, and to the process of manufacturing such cathodes. Its object is to provide electron-emitting cathodes having greatly increased durability and constancy of activity.

A recognized defect of oxid-coated electron-emitting cathodes has been that, though having an initially high activity, they soon deteriorate in use, becoming less and less active. In accordance with this invention, it is possible to produce cathodes having such desirably high activity and also having a uniformity of action over a very long period of use.

One feature of the process consists in applying to a platinum or other suitable electrical conductor, which becomes the heating element of the cathode, a coating consisting of an organic compound of a metal of the alkaline earth group, and then raising said coating to the ignition temperature. The process preferably includes the coating of the electrical conductor with successive coatings containing a metal of the alkaline earth group, preferably a coating or coatings of strontium hydroxid alternating with a coating or coatings of barium resinate, the latter being the preferred aforementioned organic compound of a metal of the alkaline earth group. The final product resulting from the practice of the process is an electrode having a dense and closely adherent coating of great durability and constancy of activity when the electrode is used as an electron-emitting cathode.

In the accompanying drawing Figure 1 represents in enlarged form a portion of a filamentary conductor which has been found suitable for use as an electron-emitting cathode when treated in accordance with the process of this invention, and Fig. 2 illustrates the use of such a filament in a thermionic repeater of the audion type.

The invention, both as a process and as a product, will now be more fully set forth in connection with a detailed description of the preferred method of practising the process.

A twisted platinum ribbon or filament 2 having, for example, a width of three-tenths of a millimeter and a thickness of five-hundredths of a millimeter, is preferably used as the heating element. The filament is thoroughly cleansed in some suitable manner, as, for example, by dipping it for a few minutes in chromic or in nitric acid, and then washing it first in water and then in a strong solution of ammonia. The filament is then extended between the opposite electrodes of a source of electric current. In order to ascertain that there are no defects in the filament, it may be incandesced by passing an electric current through the filament. If the filament is found to be satisfactory, as evidenced by uniformity of incandescence, it is then coated with alternate coatings of strontium hydroxid and barium resinate.

The strontium hydroxid may be prepared as a stiff paste and, in such case, is diluted with water before being applied to the filament. The diluted strontium hydroxid is applied to the filament in any suitable manner, as for example by moving a trough containing the fluid lengthwise of the filament while the latter dips into the fluid in the trough. During this stage of the process, the filament is slightly heated, as for example by a current of 1.4 amperes, that is to a temperature of, for example, 100° C. Such heating facilitates the operation of coating and causes a uniform coating to be deposited on the filament. Several of such coatings are preferably applied in succession, and in practice it has been found that four of such successive layers or coatings give the most satisfactory result. After each coating, or less often if preferred, the filament is raised for a few seconds to an incandescing temperature, thus hardening the coating on the filament. The filament is next coated with barium resinate, such or-

ganic compound of barium having been found to be most suitable for obtaining a smooth, adherent and active coating. In order that the resinate may be readily applied as a coating, it is heated to a temperature that will make the resinate sufficiently fluid for that purpose. In practice, the filament has been heated electrically to a temperature of approximately 600° C., and a trough containing the barium resinate moved lengthwise of the filament, the latter dipping into the resinate and the resinate being kept sufficiently fluid by the heated filament. A number of such coatings of barium resinate may be applied in succession, preferably the same number as the aforementioned coatings of strontium hydroxid. And, as before, after each coating or after two or more successive coatings, the filament is raised for a few seconds to an incandescing temperature.

The process of alternately applying a coating or coatings of strontium hydroxid and a coating or coatings of barium resinate may be kept up until a sufficiently heavy multiple coating covers the filament or other form of electrode that is under treatment. In practice, it has been found that four successive coatings of strontium hydroxid, then four successive coatings of barium resinate, then four additional successive coatings of strontium hydroxid, and finally four additional successive coatings of barium resinate give a satisfactory result.

When the operation of coating is completed, the filament is electrically heated to incandescence for the purpose of raising the barium resinate coating to an ignition temperature, as for example, to a temperature of approximately 800° to 900° C. The coating is maintained at such high temperature for some time, for example, for about two hours.

As a result of the aforementioned treatment, the filament is covered with a dense, closely adherent film, which is believed to consist of barium oxid and strontium oxid. Said film is of exceedingly great durability and constancy of electron-emitting activity when the filament is used as the heated cathode of a vacuum tube.

What is claimed is:

1. The process of manufacturing an electron-emitting cathode, which consists in applying to an electrical conductor a coating containing a metal of the alkaline earth group; baking said coating; then applying another coating containing another metal of the alkaline earth group; and subsequently subjecting said coatings to prolonged high temperature.

2. The process of manufacturing an electron-emitting cathode, which consists in coating an electrical conductor with an oxid of a metal of the alkaline earth group; then applying another coating consisting of an organic compound of a metal of the alkaline earth group; and subsequently subjecting said coatings to a prolonged high temperature.

3. The process of manufacturing an electron-emitting cathode, which consists in coating an electrical conductor with the hydroxid of a metal of the alkaline earth group; heating said conductor and thereby converting the hydroxid coating into an oxid coating; then applying another coating consisting of an organic compound containing a metal of the alkaline earth group; and subsequently subjecting said coatings to a high temperature.

4. The process of manufacturing an electron-emitting cathode, which consists in coating an electrical conductor with a coating comprising a fluid medium and an oxid of a metal of the alkaline earth group; drying said coating; then applying a coating consisting of an organic compound of a metal; and subsequently subjecting said coatings to a prolonged high temperature.

5. The process of manufacturing an electron-emitting cathode, which consists in coating an electrical conductor with the hydroxid of strontium; then applying a coating of barium resinate; and finally subjecting said coatings to a high temperature.

6. The process of manufacturing an electron-emitting cathode, which consists in coating an electrical conductor with an organic compound of a metal of the alkaline earth group, and subjecting said coating to an ignition temperature.

7. The process of manufacturing an electron-emitting cathode, which consists in coating an electrical conductor with the resinate of a metal of the alkaline earth group, and subjecting said coating to an ignition temperature.

8. The process of manufacturing an electron-emitting cathode, which consists in coating platinum with an organic compound of a metal of the alkaline earth group, and subjecting said coating to an ignition temperature.

9. The process of manufacturing an electron-emitting cathode, which consists in coating platinum with barium resinate, and subjecting said coating to an ignition temperature.

10. The process of manufacturing an electron-emitting cathode, which consists in coating a platinum filament with an organic compound of a metal of the alkaline earth group, and then subjecting said coating to a prolonged ignition temperature by passing an electric current through said filament.

11. The process of manufacturing an electron-emitting cathode, which consists in coating platinum with alternate coatings of strontium hydroxid and barium resinate, and then subjecting said coatings to a pro-

longed ignition temperature by passing an electric current through said platinum.

12. The process of manufacturing an electron-emitting cathode which consists in slightly heating a conducting filament and passing it while heated through a coating compound containing a metal of the alkaline earth group, and then raising the temperature of the coated filament.

13. An electron-emitting cathode comprising an electrode having a multiple coating consisting of superposed coatings of the oxids of different metals of the alkaline earth group.

14. An electron-emitting cathode comprising an electrode having a multiple coating consisting of a coating containing barium and a coating containing strontium.

15. An electron-emitting cathode comprising an electrode having a multiple coating consisting of alternate coatings of barium oxid and strontium oxid.

16. An electron-emitting cathode comprising a platinum electrode having a multiple coating consisting of superposed coatings containing different metals of the alkaline earth group.

17. An electron-emitting cathode comprising a platinum electrode having a multiple coating consisting of alternate coatings of barium oxid and strontium oxid.

In witness whereof, we hereunto subscribe our names this 23rd day of December A. D., 1914.

ALEXANDER McLEAN NICOLSON.
EMERSON CHURCH HULL.

Witnesses:
E. EDLER,
K. L. STAHL.