

Sept. 17, 1935.

C. STANSBURY

2,014,539

ELECTRON TUBE

Filed April 15, 1933

Fig. 1

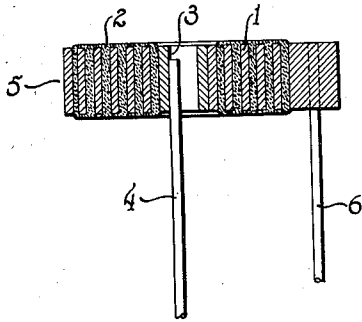


Fig. 2

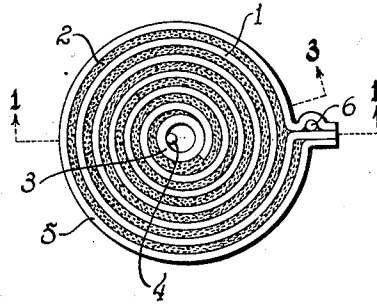


Fig. 3

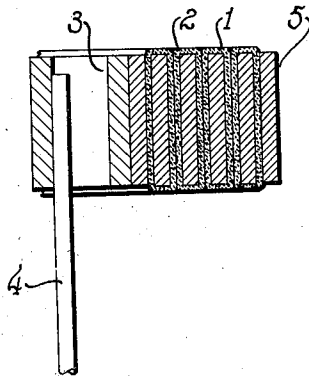
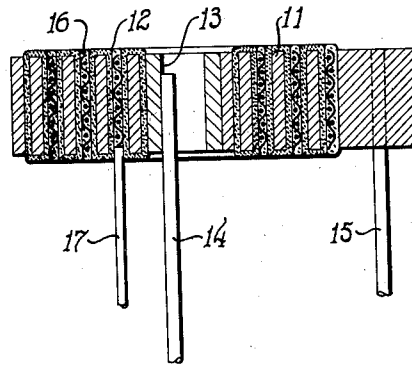


Fig. 4



Inventor
Carroll Stansbury
By Frank H. Hubbard
Attorney

UNITED STATES PATENT OFFICE

2,014,539

ELECTRON TUBE

Carroll Stansbury, Wauwatosa, Wis., assignor to
Cutler-Hammer, Inc., Milwaukee, Wis., a cor-
poration of Delaware

Application April 15, 1933, Serial No. 666,343

2 Claims. (Cl. 250—27.5)

This application is a continuation-in-part of application Serial Number 473,807, filed Aug. 8, 1930.

This invention relates to improvement in cathodes for electron discharge tubes and to a method of manufacturing such cathodes.

An object of the invention is to provide a more durable cathode.

Another object is to provide a cathode having a relatively small part of its surface exposed to bombardment by positive ions.

Another object is to provide a cathode having relatively low heat radiation.

Another object is to provide a cathode having an even temperature distribution throughout its structure.

Another object is to provide a cathode having relatively high electrical insulating resistance between adjacent parts of the conductor forming the cathode.

Another object is to provide for a cathode having a relatively low voltage drop between adjacent parts of the heating conductor.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawing illustrates two embodiments of the invention.

Figure 1 shows a cross section of one form of the improved cathode.

Fig. 2 is a top view of Fig. 1.

Fig. 3 is an enlargement of part of the section of Fig. 1.

Fig. 4 shows a modification of Fig. 1 in which the emitting electrode is separate from the filamentary heater of the cathode.

Referring to Figs. 1, 2 and 3, the cathode consists of a ribbon 1, which is covered over its entire surface with a suitable emission increasing material 2 such as the various rare earths which are employed for this purpose and then tightly wound into a spiral upon a hollow mandrel 3. The inner end of the ribbon 1 is welded, or otherwise fastened, to the mandrel which may be of metal or which may consist of a suitable insulating material. A leading-in wire 4 is connected to the inner end of the ribbon 1 or to the mandrel 3 if the latter is of metal as shown and thereby electrically connected to the inner end of the ribbon. The outer end of the spiral is surrounded by a cylindrical band or clamping ring 5 which may be electrically connected to the outer end of the ribbon 1 and which may have welded to it a leading-in wire 6. This ring serves to tightly clamp the convolutions of the spiral together during the subsequent forming process.

The current for heating the electrode passes through the wire 4 and the ribbon 1 and back through the wire 6.

To coat a cathode metal with an emission increasing substance it is the general practice to apply this substance in the form of a paste which is subsequently dried. After assembly the coated cathode is mounted in the tube and then subjected to a forming process so as to produce an active emitting surface. During this process the volume of the coating on the cathode decreases with the result that the active material may only loosely adhere to the cathode surface to be subsequently easily removed by ion bombardment. This leaves spots on the surface of the cathode bare of an active coating and reduces the emission at these spots. The current density and temperature on the remaining surface is thereby increased and this, in turn, loosens the active material so that the action becomes cumulative and the emission increasing material is soon entirely removed from the cathode and the tube loses its usefulness. The present invention avoids this difficulty.

The ribbon after being coated with a paste of emission increasing material is wound into a tight spiral which exerts a pressure on the coating and holds it in intimate contact with the metal surface of the cathode during the forming process. As a result, the material after formation is intimately united with the metal surface at all points of the latter. Once being so united, the material adheres firmly to the surface during the subsequent operation of the tube in which the cathode is used. The life of the tube is thus greatly increased and its characteristics made more constant. Where a cathode of the spiral type is desired, as in the present instance, the pressure exerted upon the emission increasing substance during the forming process is most easily applied by winding the spiral tightly and if desired the resulting pressure may be supplemented by an outer clamping ring as described heretofore but the method is equally applicable to other types of cathodes, it being only necessary to provide for holding the emission increasing material tightly against the cathode conductor during the forming process in any suitable manner. By winding the ribbon into a solid spiral, the heat diffusion in all directions is greatly increased thereby further eliminating or reducing the tendency to form hot spots.

By winding the cathode into a flat spiral only a small area thereof is exposed to positive ion bombardment while a large surface is available for

electron emission. Due to the shrinkage of the active material during the forming process a narrow space may be left between adjacent turns of the spiral so that the flat sides of the spiral ribbon are available for electron emission. The close proximity of adjacent turns of the spiral tends to reduce the ion sheath and to shift it to the edge of the spiral ribbon thus still further reducing the effect of ion bombardment.

The emission increasing material is a relatively good insulator against the flow of electric current by conduction and thus the material between adjacent turns serves as an effective insulator against short circuits between such turns. It will furthermore be observed that the potential between adjacent turns of the ribbon is a minimum and that the ends of the ribbon are separated from each other by a number of layers of insulation in series so that the voltage gradient between such ends is relatively low and the tendency for the heating current to pass from one leading-in wire to the other through the mass of the electrode is thereby minimized, even if the coatings of adjacent turns should touch.

It is sometimes desirable to employ an emitting electrode which is electrically insulated from the heating wire. Fig. 4 shows such an electrode. The heating ribbon 11 which may be covered with an insulating or emission increasing material 12 is wound upon a mandrel 13. The ends of the ribbon are provided with leading-in wires 14 and 15 in the manner aforescribed. Between adjacent turns of the ribbon is wound a second ribbon preferably of wire mesh 16 which also is covered with an emission increasing material 12. This second ribbon which forms the cathode proper is equipped with a leading-in wire 17.

It will be noted that in this construction, the

emission electrode 16 proper is insulated from the heating ribbon by the layers of emission increasing material while at the same time the entire electrode forms a practically solid mass of high heat conductivity in all directions similar to that aforescribed.

It is obvious that in view of the fact that the emitting ribbon 16 is covered by an emission increasing material which is an electrical insulator it is not absolutely necessary to cover the ribbon 11 with the same material for insulating purposes, or if preferred the ribbon 11 may be covered with some other suitable insulating material which has no emission increasing characteristics. It is also apparent that the emitting ribbon or element 16 may consist of a solid or perforated ribbon instead of a wire mesh or may assume other suitable forms.

What I claim as new and desire to secure by Letters Patent is:

1. An electron discharge tube having a cathode which consists of a heater ribbon and a parallel emitting conductor, said conductor and said ribbon comprising alternate layers of a compact spiral and being coated with and separated from each other by an insulating and emission increasing material comprising a compound of an alkaline earth.

2. An electron discharge tube having a cathode which consists of a heater ribbon and a parallel emitting conductor wound as alternate layers of a compact spiral, said conductor and said ribbon being coated with and separated from each other by an insulating and emission increasing material consisting of a compound of an alkaline earth, said conductor being provided with interstices to retain said emission increasing material.

CARROLL STANSBURY.