

Jan. 29, 1929.

1,700,454

E. E. SCHUMACHER

ELECTRON EMITTER AND PROCESS, OF MAKING THE SAME

Filed July 8, 1924

Fig. 1

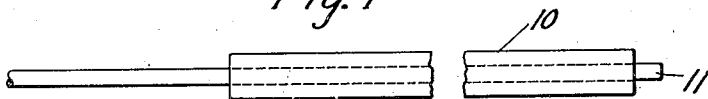


Fig. 2

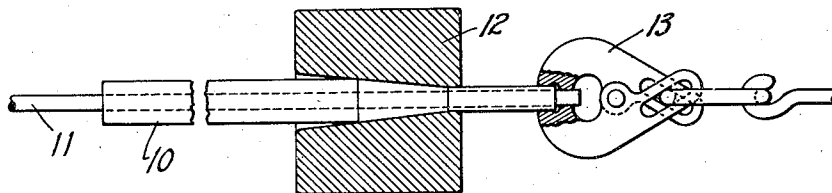


Fig. 3

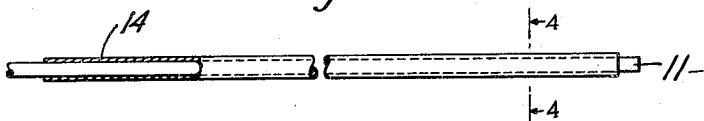


Fig. 4



Inventor:
Earle E. Schumacher.
by *E. W. Adams* Atty

UNITED STATES PATENT OFFICE.

EARLE E. SCHUMACHER, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

ELECTRON EMITTER AND PROCESS OF MAKING THE SAME.

Application filed July 8, 1924. Serial No. 724,809.

This invention relates to thermionic emitters and has for its object a filament adapted to be coated with thermionically active materials to form an emitter and a process of making the filament.

The electrical and physical characteristics of highly refractory metals, such as tungsten, molybdenum and tantalum, make these metals desirable as cores for electron emitters. However, when metals such as these are coated with alkaline earth oxides in the presence of air, they oxidize due to the heat treatment accompanying the coating process and the oxides form with the alkaline earth oxides, compounds of the metals which do not break down when heated in vacuum to the oxides of the alkaline earths. The thermionic activity of an emitter comprising an alkaline earth oxide coated filament of one of these metals is, therefore, relatively low.

In accordance with this invention, there is provided for filaments of these metals a thin coating of a metal, the oxide of which combines with alkaline earth oxides when heated in air to form a compound which breaks down when heated in vacuum to the oxides of the alkaline earths. The composite wire thus formed retains the advantageous electrical and physical characteristics of the highly refractory metals and may be coated with alkaline earth oxides by heating in air without any deleterious effects.

Referring now to the drawings, Figs. 1 and 2 illustrate the process of forming the core and Figs. 3 and 4 disclose the finished product.

The first step in the process consists in providing a cylinder 10 of the metal which is to form the protective coating. The cylinder is slipped over one end of a filament 11 of refractory metal, the cylinder having a bore of slightly greater diameter than the diameter of the filament. The cylinder 10 is of considerably larger outside diameter than the filament 11 and is also much shorter. One end of the cylinder is pointed or tapered by hammering or other treatment, after which the point is inserted in a die 12. The ends of the filament and cylinder are gripped by a clamp 13 and drawn through the die. By this drawing operation the diameter of the cylinder 10 is reduced and the material forming it, spread along the filament. The drawing operation is repeated until the cylinder

is reduced to a very thin coating for the filament as is shown in Figs. 3 and 4.

This method can be used in the formation of cores to be coated with alkaline earth oxides to form electron emitters. The filament 11 is composed of highly refractory metals such as tungsten, tantalum, molybdenum and similar metals having desirable physical and electrical characteristics for cores for electron emitters but which cannot be coated with alkaline earth oxides by heating in air because of the fact that their oxides combine with alkaline earth oxides when heated in air to form compounds of low thermionic activity which do not break down when heated in vacuum to alkaline earth oxides. The coating applied to the filament is composed of a metal such as nickel, cobalt, platinum, or other similar metal, the oxides of which react when heated in air with the alkaline earth oxides to form compounds which break down to alkaline earth oxides when heated in vacuum.

The cores are coated with alkaline earth oxides preferably according to the method set forth in the patent of Carl D. Hocker, No. 1,545,256, issued July 7, 1925. As the coating of the core is comprised of a metal the oxide of which when heated reacts with alkaline earth oxides to form compounds which break down to the alkaline earth oxides when heated in vacuum, the coating process may be carried on in the open air without in any way affecting the activity of the electron emitter thus formed.

It is, of course, understood that combinations of metals other than those specifically mentioned may be used in carrying out the process without in any way departing from the spirit of the invention as set forth in the appended claims.

What is claimed is:

1. A thermionic cathode comprising a core of a metal capable of standing a high degree of temperature, a metallic sleeve on said core, and a coating of alkaline earth oxide on said sleeve, the metal of which said sleeve is composed being one whose oxide, when heated in air, reacts with alkaline earth oxide to form compounds which, when heated in vacuum, break down to alkaline earth oxide.

2. A thermionic cathode comprising a tungsten core, a metallic sleeve thereon, and a coating of alkaline earth oxide on said sleeve,

the metal of which said sleeve is composed being one whose oxide, when heated in air, reacts with alkaline earth oxide to form compounds which, when heated in vacuum, break
5 down to alkaline earth oxide.

3. A thermionic cathode comprising a core of a metal capable of standing a high degree of temperature, a nickel sleeve thereon, and a coating of alkaline earth oxide on said sleeve.

10 4. A thermionic cathode comprising a core of tungsten, a nickel sleeve thereon, and a coating of alkaline earth oxide on said sleeve.

5. A process of forming a thermionic cathode which comprises drawing a protective sleeve around a metallic core, and coating
15 said sleeve with thermionically active material.

6. A filament comprising a core of highly refractory metal, a sleeve of nickel-like metal thereon and a coating of thermionically ac-
20 tive material on said sleeve.

In witness whereof, I hereunto subscribe my name this 2 day of July, A. D., 1924.

EARLE E. SCHUMACHER.