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J. A. BECKER  
ELECTRON EMITTER  
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1,957,486

FIG. 1

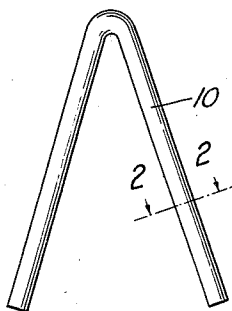


FIG. 3

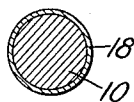
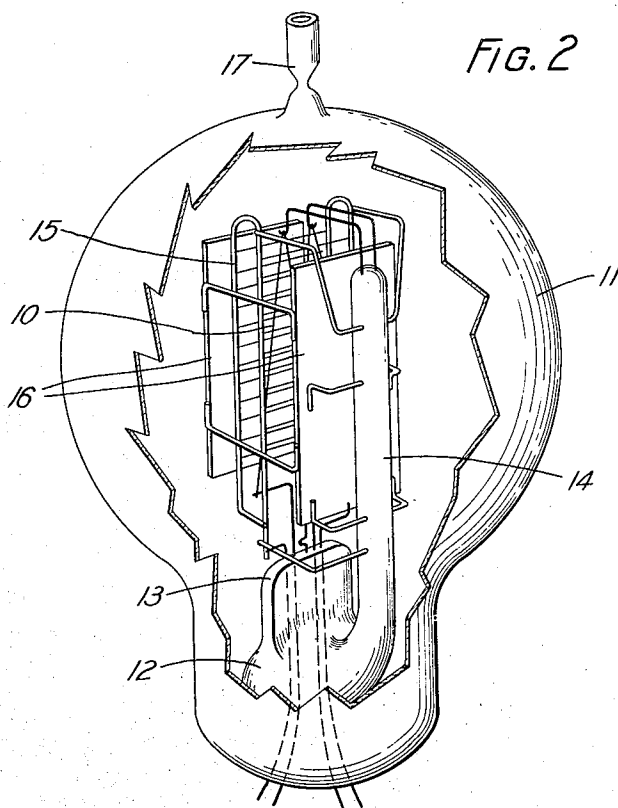


FIG. 2



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## UNITED STATES PATENT OFFICE

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## ELECTRON EMITTER

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4 Claims. (Cl. 250—27.5)

This invention relates to electron emitters for electron discharge devices, and a method of making them.

An object of the invention is to improve the characteristics and operating life of thermionically active cathodes or emitters.

In accordance with a broad aspect of the invention, a cathode is produced by combining osmium and an electro-positive element, both being in a relatively pure state, into a suitable form to be employed in electron discharge devices.

In a more specific aspect of the invention an alloy is produced of osmium, platinum and metals of the alkaline earth group in an evacuated vessel. Metals of the alkaline earth group or rare earth group are especially desirable for their thermionic characteristics. Preferably metallic barium or a combination of barium and strontium is introduced into the evacuated vessel with osmium and platinum and heated to such a temperature that an alloy is formed in which the barium and strontium is intimately mixed with the osmium and platinum. The alloy produced in this manner is then drawn into wire form, preferably in a non-oxidizing atmosphere, and is suitable for the cathode of an electron discharge device. The cathode produced in accordance with this invention has certain characteristics which are superior to an oxide-coated cathode. For instance, the process is simplified and less expensive since the operations are considerably reduced. The thermionically active pure metal in the cathode gives it greater activity, longer life, and less change in activity during operation.

A more detailed description of the invention follows and is illustrated in the accompanying drawing, in which Fig. 1 illustrates a metallic alloy cathode made in accordance with this invention, Fig. 2 illustrates one embodiment of the invention in a three-electrode discharge device, and Fig. 3 is an enlarged cross-sectional view on the line 2—2 of the cathode shown in Fig. 1.

The thermionically active cathode is produced in one embodiment of the invention by combining metallic osmium and a metal or metals of the alkaline earth group into an alloy which may be formed into a suitable shape to be used as cathodes or electron emitters for discharge devices. In the preferred arrangement for producing this alloy metallic osmium and any electro-positive metal or combination of metals, such as metals of the alkaline earth group, alkali metals, or metals of the rare earth group, may be combined in an evacuated vessel to form the alloy. It may be desirable to include a small quantity of platinum

in the alloy in order to increase the workability of the alloy. After the alloy is formed, it may be drawn into a wire by well known methods. Preferably, the drawing operation should be performed in a non-oxidizing atmosphere. The alloy wire 10 may then be bent into a form, shown in Fig. 1, and mounted in an electron discharge device, as shown in Fig. 2. This device comprises an evacuated glass vessel 11 having a reentrant stem 12, terminating in a press 13, in which are sealed the leading-in wires for the electrodes. A glass arbor 14 is fused to the side of the stem and extends substantially parallel to the axis thereof. The alloy cathode 10 of this invention is resiliently supported from the arbor 14. A grid 15 and an anode or plate electrode 16 are supported in cooperative relation to the cathode 10 by wires extending from the arbor 14.

The vessel 11 is connected to a vacuum pump (not shown) by means of the tubulation 17, whereby the gases are removed from the electrodes in the device. During this operation suitable potentials may be applied to the electrodes to heat the electrodes and remove the gases by electron bombardment. The cathode 10 is heated during the degassing operation so that some of the electro-positive metal, such as barium and strontium, contained in the core 10 of the cathode is diffused to the surface thereof and forms a thin film or molecular layer 18 of thermionically active metal. The tubulation 17 may then be sealed off from the vacuum pump and the device may be used for any desirable purpose. A suitable cathode may also be produced by forming a metallic wire core in which osmium is incorporated. It is desirable for the purposes of this invention that the core material combined with osmium should be a metal of the platinum group in order to preserve the high work function of the osmium. The osmium alloy wire may then be enclosed in an evacuated vessel in which a supply of electro-positive metal, such as metallic barium and strontium is present. The electro-positive metal is heated to such a temperature in vacuum that the metal is rendered volatile and alloys with the osmium alloy wire to form a thermionically active metallic coating on the wire. The osmium may also be electro-plated onto a suitable core such, for example as tungsten or platinum. The barium is then alloyed with the osmium by the above described method.

The alloy cathode made in accordance with this invention can be produced by a method which is simpler than the method of producing oxide-coated cathodes and is also less expensive.

Furthermore, the mixture of the thermionically active metal throughout the core serves as a reservoir of active material which may be diffused to the surface of the core. Another advantage of this cathode is the intimate contact of the metallic layer 18 on the core. This is accomplished by the use of osmium in the alloy core, which has a relatively high work function and low vapor pressure.

While the invention has been described with respect to a particular embodiment thereof, it is understood that various modifications may be made in the material employed for making the alloy cathode, and the invention is only to be limited within the scope of the appended claims.

What is claimed is:

1. An electron emitter comprising a core consisting of osmium, said core being alloyed with a metal of the alkaline earth group.

2. An electron emitter comprising a core consisting of osmium, said core being alloyed with metallic barium.

3. An electron emitter comprising an alloy core consisting of osmium, and metallic barium and metallic strontium intimately mixed with said core.

4. The method of making a thermionically active cathode containing osmium and an alkaline earth metal, which comprises combining said osmium and alkaline earth metal in an evacuated vessel to form an alloy, drawing said alloy into a wire, inserting said wire in a vessel, evacuating said vessel, and heating said cathode during evacuation to diffuse a thin film of said alkaline earth metal to the surface of said wire.

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