July 7, 1931. E. A. LEDERER 1,813,704

CATHODE

Filed June 26, 1928

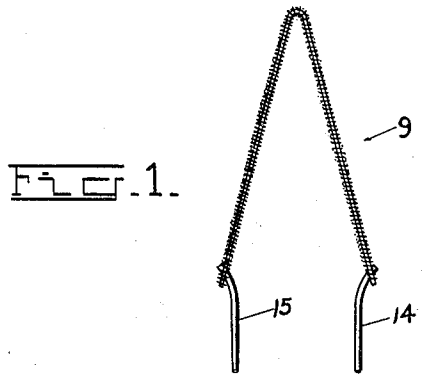


Fig. 1.

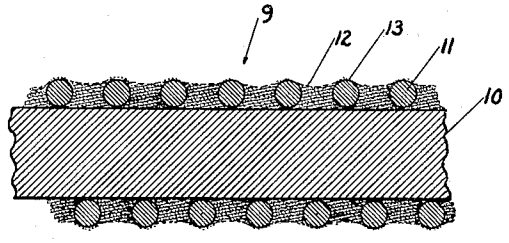


Fig. 2.

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UNITED STATES PATENT OFFICE

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CATHODE

Application filed June 26, 1928. Serial No. 288,348.

This invention relates to electron emission devices and relates more particularly to the cathode as employed in devices such as rectifiers or the like.

In the manufacture of certain types of electron emission devices, a conductor is employed having thereon a deposit of an electron emission material. Usually the conductor consisted of a filamentary body or wire which was immersed in a suspension of the material to be deposited, which adhered to the wire in the form of a coating. A coating so applied offered considerable disadvantage in handling and general manipulation when applied to the device in which it was to be employed. Usually the coating was of a fragile nature and easily disturbed through accidental contact or mechanical abrasion. Moreover, when it was found desirable to apply a relatively thick coating to the wire by repeated immersion and drying of the coating to build up the layer, the above disadvantages were augmented by the fact that the coating was subject to rupture in the form of cracks if the wire upon which the coating was deposited was distorted, as by bending. It was, therefore, difficult to properly coat a conductor with an amount of an electron emission material sufficient to withstand gas bombardment, as often attends the operation of certain types of electron emission devices.

It has also been found that in conductors as heretofore coated with a layer of an electron emission material, which is usually an oxide of low electrical conductivity, difficulty is experienced in welding the ends of the conductors to suitable lead wires and that it becomes necessary, prior to the welding operation, to scrape the ends to be welded free from the coating.

It is an object of the present invention, therefore, to provide a cathode with means for retaining thereon a relatively large amount of an electron emission material.

Another object of the invention is to provide an electrode arranged to mechanically retain a deposit of an electron emitting material thereon.

Another object of the invention is to provide an electrode having thereon a coating of an electron emission material and free from a deposit detrimental to a welding operation.

Other objects and advantages of the invention will be evident from the following description, together with the accompanying drawing, in which

Figure 1 shows a filament constructed in accordance with the present invention, secured to leading-in conductors; and

Figure 2 is an enlarged sectional view of a portion of the filament shown in Figure 1, illustrating the formation of the deposited material.

In practicing the present invention an electrode 9 is produced by providing a mandrel 10 and winding thereon a relatively fine wire 11 in helical formation. The core material or mandrel may be made, for example, of 5 mil diameter platinum wire, while the coiled wire may be of 2 mil diameter and also of platinum wire. It is obvious, however, that other materials may be used, as for example, nickel, tungsten, molybdenum, or various combinations of these or other wires.

The operation of applying the wound wire to the mandrel may be the same as that well known in the manufacture of coiled filaments wherein a filament wire is wound upon a mandrel wire. In the case of a filament, however, the mandrel is subsequently removed, whereas in the present case the mandrel remains within the coil. In this manner the body portion of an electrode constructed in accordance with the present invention may be made at high speed and at relatively low cost. After the mandrel has been wound with the helical coil 11, which may be termed a retainer wire or element, a coating 12 may be applied in any suitable manner so that it becomes deposited in the form of a spiral about the mandrel and between the turns of the wire 11. The material 12 may be applied in any suitable manner, as for example, by passing the wound mandrel through a suspension of the material to be deposited thereon. Any suitable electron emission material may be used,

as for example, 50% of barium and 50% strontium, or 30% barium, 30% strontium and 30% calcium carbonate.

It will be evident that an electrode constructed in accordance with the present invention makes it possible, not only to deposit a large amount or thick layer of a given material upon the electrode but that by reason of the spaces between the turns of the wire and the circular formation of the wire bordering the said spaces, the deposit when hardened will become locked in position since, by reason, of the capillary attraction, the material when in suspension will entirely fill the spaces between the turns so that portions of the deposit will engage the turns of the wire at a point adjacent to the mandrel and thereby become mechanically secured against lateral or outward movement, thus providing a fabricated structure having cavities or interstices to receive electron emission material.

Ordinarily when immersing the mandrel wound wire in the bath of the material to be deposited, only an extremely thin film remains upon the outer side 13 of the coiled wire, leaving the outer surface substantially free from the coating. This is of advantage since it is necessary to secure the ends of the filament to leading-in conductors 14 and 15, as shown in Figure 1. This has heretofore been a somewhat difficult operation since the coating, which is an oxide, is highly non-conductive to heat and offers opposition to welding, making it necesssary to scrape off portions of the coating before an effective welding operation can be performed. In the case of a clamping operation, where the lead wires are clamped to the filament, it has heretofore been necessary to remove portions of the coating in order to obtain the desirable electrical connection which would otherwise not be possible by reason of the intermediate layer of the coating.

In the present invention the top surface of the turns of the wound wire 11 are substantially free from the coating, or if a film remains it is negligible insofar as any detrimental effects upon the welding or clamping operation are concerned.

In practice it has been found that a cathode made in accordance with the present invention can be welded to a support wire without the operation of cleaning or scraping the surface to be welded and that a firm bond is produced with the required electrical conductivity.

Although a preferred embodiment of the invention is shown and described herein, it is to be understood that modifications may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A cathode for an electron emission device comprising a core having a wire wound thereon to provide grooves and an electron emission material encasing said wound wire and substantially filling said grooves.

2. A cathode for an electron emission device comprising a supporting body, a wire wound on said body with the turns in space relation to provide grooves and an electron emission material deposited in and substantially filling the grooves between the turns of said wire.

3. A cathode for an electron emission material comprising a mandrel, a wire helically wound upon said mandrel with the turns of the wire in space relation and a deposit of an electron emission material on the exposed surface of said mandrel between the turns of said wire.

4. A cathode for an electron emission device comprising a mandrel of a refractory material, a winding of a refractory wire with the turns in space relation upon said mandrel and a deposit of an electron emission material on the surface of said mandrel between said turns, said deposit substantially filling the space between said turns and being secured between surfaces of adjacent turns.

5. A cathode for an electron emission device comprising a mandrel wire of relatively large diameter, a wire of relatively fine diameter wound in helical formation with the turns in space relation upon said mandrel wire and a deposit of an electron emission material occupying the space between the turns of said wire.

In testimony whereof, I have hereto subscribed my name this 25th day of June, 1928.

ERNEST ANTON LEDERER.