

UNITED STATES PATENT OFFICE

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GETTERING

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7 Claims. (Cl. 250—27.5)

This invention relates to gettering gases in electron discharge devices.

In the United States Patent 1,958,967 issued May 15, 1934, a discharge device is described in which an electrode carries, in the form of a porous solid layer, metals such as powdered zirconium, or tantalum, which have a high melting point and getter gases at operating temperatures. These highly oxidizable metal powders, which do not easily evaporate, have better heat radiation properties than shiny metals and they retain during extended use a constant heat radiation property.

Such layers or coatings are produced by mixing the powdered metal in a suspending agent and applying to the electrode. The suspension agent is thereafter removed and the applied layer is heated in the vacuum and the porous layer is produced. However, difficulties are encountered in using these porous coverings on smooth surfaces. The layer does not properly adhere to large smooth surfaces and after an extended operating period the layer becomes brittle and peels from the base. This condition can be remedied to some extent by providing small openings closely disposed to each other in the base metal.

According to this invention, the adherence of refractory metal coatings to the carrier metals is improved. Metal coatings applied according to this invention may have a high melting point, the property of gettering gases and reducing secondary emission at operating temperatures, have good heat radiating properties, adhere well, and have a low vapor pressure. In accordance with the present invention the metal coating is provided on a base covered first with a carbon layer. It has been found that a carrier such as an electrode with a smooth metal surface may be employed because the interposed carbon layer firmly binds the coating to the carrier and eliminates the danger of peeling or loosening of the metal coating. As carrier metal, carbide forming metals or carrier metal covered by such carbide forming metal are especially suited. The carbide forming surface may have applied thereto a carbon layer which forms the base for the the coating consisting of zirconium, for instance.

The invention can be applied to advantage in transmitter tubes whose anodes and grids may be made of nickel, tantalum, molybdenum and similar metals used in electrodes to which carbon may be applied. Upon the carbon layer is painted or sprayed a coating of zirconium or similar metal having the property of binding gases and improving heat radiation and reducing secondary emission. Since the coating when applied as a

thin layer has favorable heat radiating properties, the electrodes can dissipate more power and can be loaded to a much higher degree. The gas binding properties of the covering metals appear to not be impaired by the carbide formation.

The metal electrode serving as base for the metal coating need not be perforated or roughened since the interposed carbon layer adequately adheres the metal coating to large smooth surfaces of the electrodes. As compared with the production of perforated metal sheets the carburizing method according to the present invention is much simpler. The carbon layer may be obtained from india ink applied to the base.

Metal parts, such as metal envelope walls or electrodes on the interior of electron discharge devices may be prepared according to my invention by first carbonizing the metal surfaces in any of the conventional ways, such as heating the parts in a hydrocarbon atmosphere, or by coating with carbon or graphite paste and heating in a non-oxidizing atmosphere. Upon the carbonized surfaces zirconium powder mixed in a liquid vehicle may be painted or sprayed and the parts fired in a non-oxidizing atmosphere to drive off the binders and liquid vehicles. Alternatively a compound of zirconium, such as zirconium hydride disclosed in the above mentioned patent, may be applied to the carbon coated surfaces and heated while the envelope containing the coated surfaces is being evacuated to remove the hydrogen from the compound and obtain a coating of pure zirconium.

The precise chemical reactions that take place when the zirconium is heated on the carbon is not known, but it is believed that at certain high temperatures carbides of zirconium are created, at least superficial amounts of carbide between the carbon and zirconium layers. When the core is a metal which forms a carbide, such as molybdenum, there is probably a carbide layer between the carbon and zirconium and between the carbon and molybdenum and accounts for the good adhesiveness of the zirconium to the core. For best results all of the zirconium should not be converted into the carbide. Electrodes prepared according to this invention have especially good heat radiating and gettering properties. The coating has good black body characteristics, adheres well and reduces emission of primary or secondary electrons.

I claim:

1. An electron discharge device comprising a metal part, a carbon layer on said part, and a coating of zirconium on said carbon layer.

2. An electron discharge device comprising an electrode of a metal selected from the group consisting of nickel, tantalum or molybdenum, a layer of carbon on said electrode and a metal coating on said carbon layer, the last mentioned metal having a high melting point and good heat radiating and gettering properties.

3. A metal electrode for an electron discharge device having a carbide forming surface, and a coating of zirconium on said surface, and a metal carbide layer between said zirconium and the electrode for adhering the zirconium to the electrode.

4. An electron discharge device comprising a metal electrode, a layer of zirconium on said electrode, carbon between said zirconium and the metal of said electrode, said carbon merging on one side into a carbide of the metal of the elec-

trode and merging on the other side into a carbide of zirconium.

5. In combination a metal electrode, a carbide of said metal on the surface of said electrode, carbide of zirconium bonded to the carbide of said metal, and a layer of zirconium on the zirconium carbide.

6. An electrode of metal, a coating of zirconium on said metal, and an interlocking layer of carbides of zirconium and of said metal between the metal electrode and the zirconium coating.

7. An electron discharge tube having an electrode of nickel, a carbon coating on said nickel and a zirconium layer on said carbon coating with a layer of zirconium carbide between the carbon and zirconium.

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