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CATHODE

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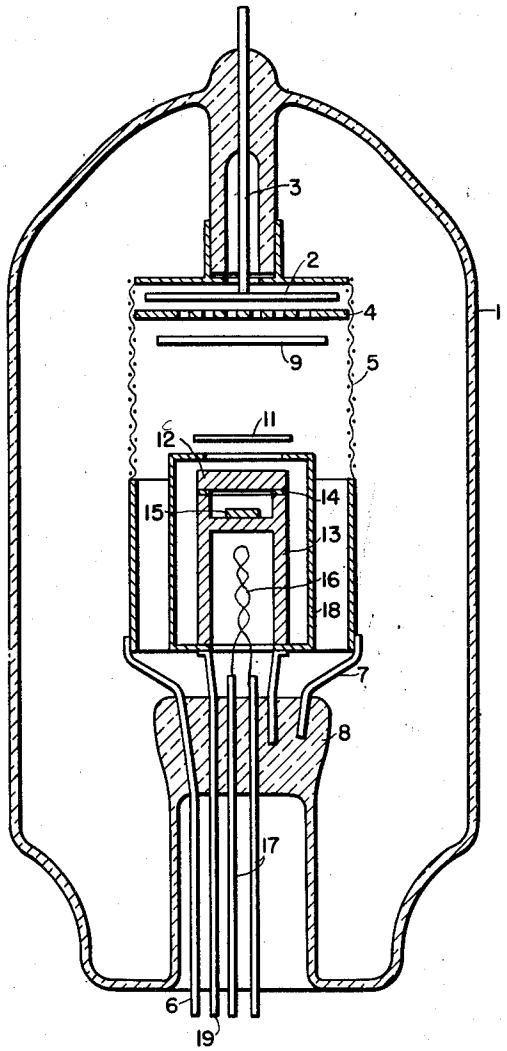

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CATHODE

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5 Claims. (Cl. 313—193)

My invention relates to thermionically-emissive cathodes and in particular relates to additions to the base material of thermionic cathodes that are activated by diffusion of the active material from within and are particularly adapted for operation in a hydrogen atmosphere.

In the U. S. Patent No. 2,121,589 to W. Espe, issued June 21, 1938, a cathode is described consisting of a porous tungsten base enclosing a cavity containing the oxides of the alkaline earth metals. The entire assembly is adapted to be heated. At the operating temperature which is near 1200° K., barium, the other alkaline earth metals and alkali metals diffuse through the porous tungsten base producing an emissive layer thereon which is capable of emitting electrons.

Cathodes of this type are found to operate satisfactorily in many respects in high-vacuum tubes and tubes having atmospheres of one of the inert gases such as argon, or even in mercury atmospheres, but their operation is poor in atmospheres containing hydrogen, since the electron-emissivity falls off badly and barium is lost rapidly by evaporation. While the operativeness of my invention is in no sense dependent upon the correctness of this theory, it is my present opinion that this poor performance where hydrogen is present is due to reduction by the latter of a thin film of oxides or oxygen which is present at the tungsten surface in the case of such cathodes operating in a non-reducing atmosphere.

One object of my invention is accordingly to provide a novel type of thermionically-emissive cathode capable of operating satisfactorily in a reducing atmosphere.

Another object is to provide a tungsten-base cathode having a coating containing barium which will operate with high efficiency in an atmosphere containing a reducing gas.

Still another object of my invention is to provide a cathode having many of the characteristics of the type of cathode as described but which will operate much more satisfactorily than the latter in an electrical discharge tube having a hydrogen atmosphere.

Still another object to provide a new and improved thermionically-emissive cathode for electrical discharge tubes.

Other objects of my invention will become apparent upon reading the following description taken in connection with the drawings in which the single figure shows an electrical discharge tube having a cathode embodying the principles of my invention.

Referring in detail to the drawings which show the application of my cathode to a thyratron, a vacuum-tight container 1, which may be of glass, is provided with an anode 2 which may be of molybdenum supported on a lead 3 which is sealed through the top of container 1. A grid 4 supported in a grid-cage 5 is positioned just below the anode 2 and attached at its lower end to a grid-lead 6 and a support-pin 7 sealed to a stem 8 of conventional form. A pair of baffles 9 and 11 are supported from the grid-cage across the direct path between anode 2 and the emissive face of cathode disc 12. The

cathode structure consists of a molybdenum cylinder 13 having an upper chamber covered by a sintered cathode disc 12 comprising a mixture of tungsten having admixed with it from 5 percent to 15 percent by weight of magnesium oxide or other oxide which is isomorphic with oxides of the alkaline-earth metals and does not react with metallic barium or evaporate substantially in the temperature range encountered by the cathode during preparation and operation.

The porous tungsten cathode disc 12 may be attached to the end of the walls of chamber in cylinder 13 by welding, and this is facilitated by interposing a ring 14 of platinum or ruthenium or ruthenium powder painted between the tungsten and the molybdenum walls. The cathode disc 12 thus forms the top of a chamber in which is placed a pellet 15 containing one or more alkaline-earth metals, such for example as a pellet made up of barium carbonate and strontium carbonate. The carbonates probably change to the oxides in the course of tube manufacture.

The lower chamber of cylinder 13 contains a cathode heater 16 of usual type supported on in-leads 17 which are sealed through press 8. The cylinder 13 is enclosed by a cathode-shield 18 which may be of molybdenum and which is supported on a cathode-lead 19 sealed through press 8. The container 1 is exhausted and provided with an atmosphere of hydrogen at a pressure of around 0.5 mm. of mercury by methods conventional in the electric discharge tube art.

The sintered tungsten base of cathode disc 12 may be formed by mixing tungsten powder with one to twenty percent by weight of magnesium oxide, molding the mixture under pressure to produce a rod, and sintering the latter in a hydrogen-atmosphere furnace at a temperature of about 1700 degrees centigrade for a time sufficient to yield an ingot having a density of about 11 to 12.

I claim as my invention:

1. A vacuum-tight container having an atmosphere including a reducing gas, a first electrode and a second electrode therein, said second electrode being thermionically-emissive and having a wall-portion consisting of a sintered mixture of tungsten with one percent to twenty percent by weight of magnesium oxide, a material including a compound of an alkaline-earth metal within said second electrode, and heater-means adjacent said second electrode.

2. A vacuum-tight container having an atmosphere including a reducing gas, a first electrode and a second electrode therein, said second electrode being thermionically emissive and comprising a wall-portion of a sintered porous mixture of tungsten with one to twenty percent by weight of an oxide which is isomorphous with the oxides of the alkaline-earth metals and does not react with barium, and a material including a compound of an alkaline-earth metal within said second electrode.

3. A thermionically-emissive electrode comprising wall-portions enclosing a chamber, said chamber containing a material including a compound of an alkaline-earth metal and one of said wall-portions comprising a sintered mixture of tungsten with magnesium oxide.

4. Within a vacuum-tight container, a cathode comprising a chamber having at one end a porous disc consisting of tungsten admixed with from one percent to twenty percent by weight of magnesium oxide, a material embodying an alkaline-earth metal near the internal face of said disc, a heater for said chamber, an anode within said container facing said disc, a grid-cage surrounding said anode and said cathode, a shield surrounding said chamber except in the region thereof facing said anode, a grid between said anode and said disc, at least one baffle plate between said grid and said disc, in-leads sealed

through said container for said anode, said grid and said cathode, and a hydrogen atmosphere within said container.

5. A thermionically-emissive electrode comprising wall-portions enclosing a chamber, said chamber containing a material including a compound of an alkaline-earth metal and one of said wall-portions comprising a sintered mixture of tungsten with an oxide which is isomorphous with the oxides of the alkaline-earth metals and does not react with barium.

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