

UNITED STATES PATENT OFFICE

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INCANDESCENT CATHODE FOR THERMIONIC TUBES AND METHOD OF MANUFACTURING SAME

No Drawing. Application filed August 28, 1929, Serial No. 389,102, and in the Netherlands August 28, 1928.

The invention relates to an incandescent cathode for thermionic tubes and methods of manufacturing the same, these cathodes being employed in transmitting and receiving valves for radio purposes, rectifiers, Röntgen-tubes, etc.

It has been proposed to manufacture incandescent cathodes with a high emission by coating the hot filament with a layer of oxide of one or more alkaline earth metals (so-called Wehnelt cathodes). The cathodes manufactured in this way have, however, various disadvantages. It sometimes happens that the oxide coating crumbles off, whereas the valves have unequal emission, and do not all last the same length of time. Moreover the oxide coating slows a noticeable resistance for the current passing from the cathode to the anode.

It has also been proposed to precipitate the alkaline earth metals from the vapour phase on a carrier, after which the carrier is heated in the presence of oxygen, the oxides thus being formed. Another way is that of previously oxidizing the carrier. The alkaline earth metals reduce these oxides, thus causing the alkaline earth oxides to be formed.

More recent experiments (e. g. Werner Espe-Wissenschaftliche Veröffentlichungen aus dem Siemens Konzern, Band V—1927) have shown that the electron emission is caused by the alkaline earth metal itself. The alkaline earth metal required for the emission is liberated from the oxide coating by an electrolytical action. The metal evaporates slowly and is continually replenished. Consequently the oxide is used to supply the alkaline earth metal. The oxide is disintegrated later on electrolytically, in order to liberate the alkaline earth metal, for which a certain minimal tension, the decomposition tension, is required.

However, this metal, when deposited on an incandescent body, evaporates so quickly that it is impossible, to manufacture a durable cathode from the metal itself.

The object of the invention is to do away with the difficulties mentioned. The cathode according to the invention is characterized by the application of one or more compounds

of one or more alkaline or alkaline earth metals, which have a lower decomposition heat than the oxides.

Another feature of the invention is that combinations are applied which do not react with the free metal. The alkaline, or alkaline earth metal compounds may comprise only two elements, viz, the metal and a metalloid. This expression "metalloids" may be defined as elements which may form oxides with acid properties and may combine with hydrogen. The compounds which may be applied are those of sulphur, selenium, tellurium, red phosphorus, arsenic and antimony.

The method for the manufacture of the incandescent cathodes according to the invention consists substantially in precipitating the metalloid and the metal on the filament.

According to an embodiment of the invention the filament is submerged in a liquid containing substances which are disintegrated when heated, thereby supplying the desired metal-metalloid compounds. By heating the filament treated in this way with an alkaline or alkaline earth metal, the compounds of the said metal with the metalloid are produced.

The compounds on the filament may also be produced from the elements themselves.

The cathode according to the invention can also be manufactured by previously coating the carrier with a metal, the metal being subsequently converted into a compound reacting with the alkaline or alkaline earth metal, to produce the desired compound.

By way of example we shall now describe, in what way a bariumselenide cathode is manufactured. A filament of a metal with a high melting point, e. g. tungsten, molybdenum, tantal, etc. is dipped in a solution of ammoniumselenotungstate, after which the filament is heated by passing a current there-through in an atmosphere of nitrogen or one of the rare gases. When this has been done tungstensenide is present on the filament. The filament is then mounted in the tube, and the vapour of an alkaline earth metal is precipitated on the filament. Then the filament covered with metallic barium is heated, thus causing bariumselenide and

metallic tungsten to be produced on the filament. The coating obtained in this way has a great emission capacity and is better in every respect than the oxide coating.

5 It is also possible to start from the oxide cathode, and to use bariumsulphide, -selenide or -telluride. A cathode of this kind may be manufactured in the way described above, but with this difference that instead of ammoniumselenotungstate, e. g. a mixture of
10 ammonium tungstate and ammoniumsulpho-, seleno- tellurotungstate is used.

Very good results may be obtained by coating a filament galvanically with a metal, e. g. copper, and by converting this metal subsequently into sulphide, selenide, telluride, phosphide, arsenide or antimonide.

The method may then be as follows. The galvanically coated filament is mounted in the frame, and then the whole is placed under a bell jar which can be heated and evacuated. Under the jar there is a quantity of sulphur, selenium, tellurium, red phosphorus, arsenic or antimony. During the action of the vacuum pumps the jar is heated, after which the whole is allowed to cool down. The filament is now covered with a thin, equal coating consisting of a compound of the metal produced galvanically with the metalloid. The frame may then be introduced into the tube, and the further treatment corresponds to what has been described above.

The process according to the invention has the advantage of the alkaline or alkaline earth metal being more easily liberated by an electrolytical action from the compounds mentioned, than from the oxide. Therefore the alkaline or alkaline earth metal is already liberated by a smaller emission current which eliminates the disadvantage of the emission in oxide cathodes decreasing, when a small emission current is used.

The method according to the invention causes the alkaline or alkaline earth compound to be produced at a low temperature from the corresponding metal, and the metal compound supplied.

The danger of the cathode being destroyed, the introduced metal evaporating, and the coating dropping off through the difference in the expansion coefficients of coating and carrier, is prevented, while the manufacture entails fewer difficulties.

I claim:

55 1. A process for manufacturing incandescent cathodes comprising coating a core with a metal-metalloid compound and a metal of the group comprising the alkaline and alkaline earth metals; and heating the coated
60 core in a non-oxidizing atmosphere to produce compounds of the metals of the group comprising the alkaline and alkaline earth metals with the said metalloid disintegrating more readily than the corresponding
65 oxide.

2. A process for manufacturing incandescent cathodes comprising submerging a core into a liquid containing substances which decompose by heating thereby supplying metal-metalloid compounds, coating the said core with a metal of the group comprising the alkaline and alkaline earth metals; and heating the core in a non-oxidizing atmosphere to produce compounds of the metal of the group comprising the alkaline and alkaline earth metals with the said metalloid disintegrating more readily than corresponding oxide.

3. A process for manufacturing incandescent cathodes comprising coating a core with tungsten selenide and barium, and heating the core in a non-oxidizing atmosphere to produce compounds of barium and selenium.

4. A process for manufacturing incandescent cathodes comprising coating a core with a metal-metalloid compound, an oxide and a metal of the group comprising the alkaline and alkaline earth metals; and heating the core in a non-oxidizing atmosphere to produce compounds of the metal of the group comprising the alkaline and alkaline earth metals with the said metalloid disintegrating more readily than the corresponding oxide.

In testimony whereof I affix my signature.
ERNST WINTER.

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