

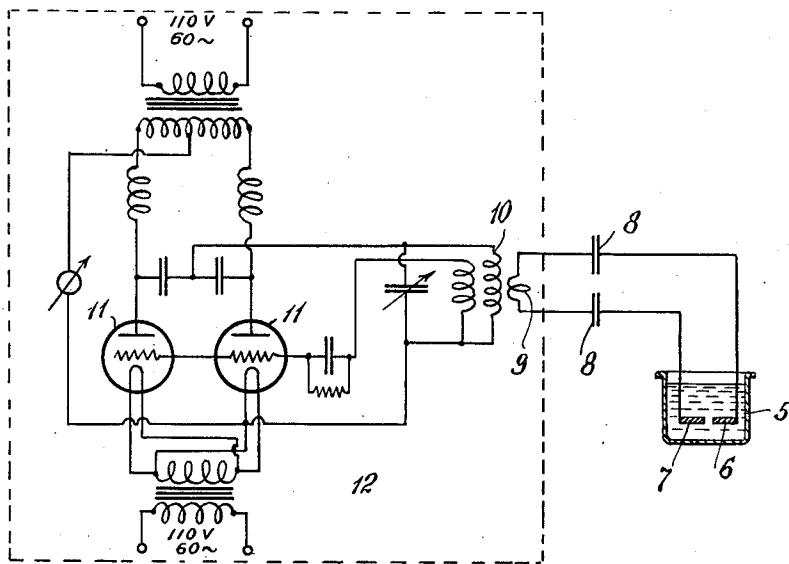
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ELECTRON EMITTING CATHODE AND PROCESS OF PREPARING THE SAME

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ELECTRON-EMITTING CATHODE AND PROCESS OF PREPARING THE SAME.

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In the manufacture of oxide coated electron-emitting cathodes much difficulty has been encountered due to the fact that it has been impossible to obtain coatings of the pure oxide of the alkali-earth since these materials have a tendency to absorb carbon dioxide and water which tend to change the oxides into hydroxides and carbonates.

In accordance with the present invention, an improved process of obtaining substantially pure oxides on the filament is provided by making a colloidal solution of the alkali-earth metal employed and then changing this material to an oxide without using the intermediate steps of reducing the oxide from a carbonate or hydrate of the metal.

The method employed will best be understood by describing the various steps followed in the manufacture of an electron-emitting cathode. A colloidal solution of one or more of the alkali-earth metals, such as calcium, barium or strontium, is produced by "sputtering" electrodes of these materials under pyridine (C_4H_5N) which is effected in the following manner:

A vessel, such as 5, containing pyridine, has electrodes 6 and 7 immersed therein. These electrodes may be formed of some alkali-earth metal, such as calcium, strontium or barium, or one of these electrodes may be of strontium and the other of barium, or any combination of these metals. It is also possible to use misch-metal for the several electrodes. These electrodes form a spark-gap and are electrically connected through condensers 8 to the secondary winding 9 of a transformer, the primary winding 10 of which is connected to high frequency oscillators 11 preferably of the vacuum tube type, generally designated 12. This transmitter has included in its circuit small inductance and large capacity for the purpose of developing a low voltage and large current of high frequency. Under the action of a high frequency arc thus developed the metal of the electrodes 6 and 7 is "sputtered" in the form of fine particles into the pyridine to form a colloidal solution. The particular advantage of the use of pyridine is that the calcium, barium or strontium, does not form oxides until all the pyridine has been evaporated. High frequency is used to prevent any electrolytic effects.

The colloidal solution thus prepared may

be applied in any suitable manner, such as by dipping, or by an electrophoresis method, which consists in placing the filament in the colloidal solution in which an electrode is immersed. A sufficient difference of potential is maintained between the electrode and the filament so that the metal suspended in the colloidal solution is deposited on the filament. After one or more coatings the filament is heated in any suitable manner in an atmosphere of air or oxygen to evaporate the pyridine and the filament is then further heated to transform the alkali-earth metal or metals deposited on the filament to oxides.

According to one method of carrying out the invention, two electrodes of calcium, each weighing about two grams, were immersed in a vessel containing fifty cubic centimeters of pyridine. An arc was developed between the electrodes and a current was passed between them through the pyridine for about one-half hour until a homogeneous colloidal solution, dark brown in color, was formed. For this current, a high frequency vacuum tube oscillator having an output of fifty watts at a frequency of one and one-half million cycles was used. The colloidal solution thus formed was permitted to stand about a day to permit the larger particles to settle. The colloidal solution of metallic calcium thus obtained was then applied by electrophoresis to a platinum filament about ten mils wide and one-half mil thick, by placing the filament in the colloidal solution in which there was suspended a platinum electrode about one-half inch wide and one-half mil thick and a difference of potential of ten volts was developed between the filament and the electrode with the filament being maintained negative. The filament was left in the solution for about one-half hour at which time a black coating was present on the filament. The filament was then heated in air at about $150^{\circ}C$. to evaporate the pyridine and it was then further heated in air for about ten minutes at $700^{\circ}C$. to change the calcium to an oxide. The coating obtained in this manner was very fine and adhered strongly to the filament.

I claim:

1. The process of preparing an electron-emitting cathode which consists in suspending finely divided metal of the alkali-earth group in a non-oxidizing medium, electri-

cally depositing the metal from said medium on a conductor, and subjecting said conductor to heat.

2. The process of preparing an electron-
5 emitting cathode which consists in forming a colloid solution of an alkali-earth metal by "sputtering" said metal in a liquid by means of a high frequency arc, depositing said colloidal metal on a conductor to form
10 a coating, and then heating the coated conductor.

3. The process of preparing an electron-
emitting cathode which consists in suspend-
ing a finely divided metal of the alkali-earth
15 group in pyridine, applying a coat of metal in pyridine to a conductor, and subjecting the conductor to heat to evaporate the pyridine.

4. The process of preparing an electron-
20 emitting cathode which consists in "sput-

tering" a metal of the alkali-earth group in pyridine, applying the metal in pyridine to a conductor, and subjecting the conductor to heat to evaporate the pyridine.

5. The process of preparing an electron- 25
emitting cathode which consists in "sputtering" a metal of the alkali-earth group in pyridine, electrically depositing the "sputtered" metal from the pyridine on a conductor, and subjecting the conductor to heat to
30 evaporate the pyridine.

6. The process of preparing an electron-
emitting cathode which consists in "sput-
tering" a plurality of metals of the alkali-
earth group in pyridine, applying the metals 35
suspended in the pyridine to a conductor, and then subjecting said conductor to heat to evaporate the pyridine.

In testimony whereof I affix my signature.

FREDERICK HOLBORN.