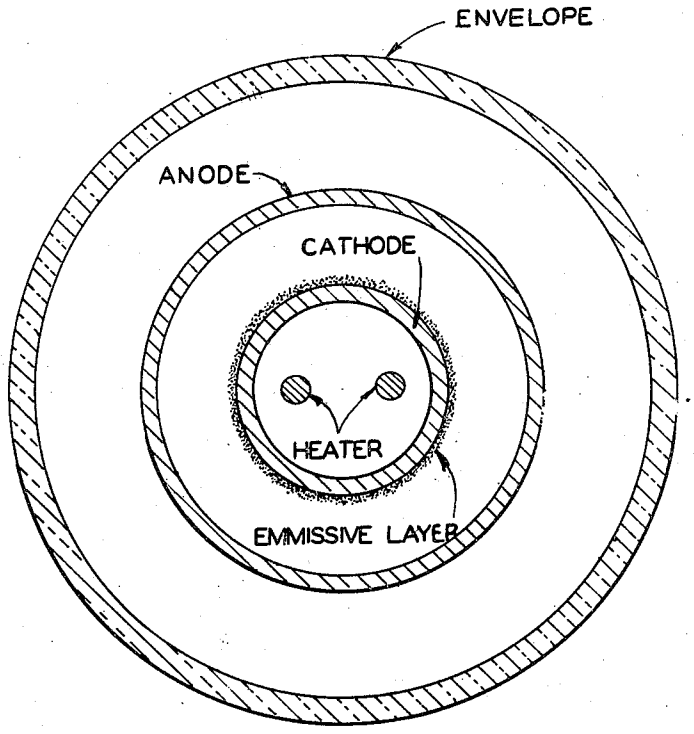
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PROCESS FOR MANUFACTURING CATHODES FOR ELECTRON DISCHARGE TUBES

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PROCESS FOR MANUFACTURING CATHODES FOR ELECTRON DISCHARGE TUBES

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1

Different processes are known by which the emissive layer of a cathode of an electric discharge tube may be obtained. One of the oldest processes consists in that from a certain spot inside the tube barium is applied by vaporisation to a substratum, which serves as a core, said barium being obtainable either by heating and decomposition of a certain amount of barium azide, or by heating alloys such as barium magnesium, barium aluminum and the like, or reduction mixtures, for example barium oxide with magnesium, aluminum or zirconium. Such processes have been abandoned in practice since in this case the alkaline-earth metal vaporizes through the whole of the tube and may deposit on undesirable spots and then lead to disturbing emission phenomena, for example to an alkaline-earth metal mirror on the wall and, in certain cases, to short-circuit between the different electrodes and/or other components of the tube.

The process which is most used in practice nowadays for applying a layer having a capacity of emitting electrons is the process according to which one or a plurality of alkaline-earth carbonates are applied to a cathode core, in some manner or other, for example by spraying, dipping, by electrolytic or electrophoretic means, whereupon after the cathode thus obtained has been incorporated into the tube, the carbonates are transformed into oxide by heating. This decomposition is usually effected after all the other components of the tube have been deprived of gases, and the carbonic acid produced during this decomposition must therefore either be pumped off rapidly, or be absorbed by a gas-binding material. Since the amount of carbonic acid that is separated is comparatively great, other parts of the tube may take up gas again. Although the emission of the oxide layers thus formed is satisfactory per se, in numerous cases difficulties occur if for short waves it is desired to use thin layers, for example layers having a thickness of less than 10 microns. In this case it appears to be extremely difficult by this carbonate process to obtain layers having both a satisfactory emission and a sufficiently long period of life.

The drawbacks set out above may be obviated by utilising a process of manufacturing a cathode of an electric discharge tube according to the invention. This process consists in preparing a cathode in a separate vacuous space in such a manner that from some mixture or other a compound, or an alloy alkaline-earth metal is evaporated and deposited on to a core which superficially consists, for example, of nickel oxide or copper oxide, whereupon this core is heated so as to form a layer of one or a plurality of alkaline-earth oxides and, subsequently, the cathode thus obtained is exposed for some time to an atmosphere containing carbonic acid, for example air, and at last incorporated into the ultimate tube and heated for a few moments.

2

This process yields a cathode which exhibits a very satisfactory and reproducible emission and has, in addition, a sufficiently long period of life. The layer itself is very thin; layer thicknesses smaller than 10 microns are in this case normal and it is readily possible to go as far as thicknesses of the order of magnitude of from 0.1 to 1 micron. In the tube in which this cathode is used any alkaline-earth metal is not vaporised, nor deposited on the wall and other parts. Consequently, there are no difficulties involving short-circuits, the production of a barium mirror on the wall, etc. An oxide cathode is therefore obtained which has been manufactured via the carbonate and which has a thickness which, according to the known processes of applying alkaline-earth carbonate, would lead to cathodes having a very short period of life. This small thickness of the carbonate also results in the amount of carbonic acid separated from this layer being smaller than that which is separated from the carbonate cathodes obtained by known means. The ultimate deprivation of gases of the tube is thus facilitated since a satisfactory degassing requires a low pressure, to which this small amount of carbonic acid is highly contributive.

For the process according to the present invention it is essential that the oxide layer initially produced should be brought into an atmosphere containing carbonic acid, in order to transform the oxide into carbonate. For this purpose the cathode may be most conveniently exposed to air, the more so as it has been found advantageous if the atmosphere also contains a little water vapour. The time during which this atmosphere must react on the oxide layer must not be too short, since presumably a transformation into hydroxide takes place first. It has been found that, for example, in the case of a layer thickness of 5 microns a period of at least 48 hours is required for the transformation of the oxide into carbonate.

The invention will be set out more fully with reference to a practical example in which a process according to the invention is described in greater detail.

The single figure of the accompanying drawing represents a sectional view of an electron discharge tube provided with a cathode formed in accordance with the method of this invention. For simplicity, only a diode structure is illustrated since it will be obvious that the cathode structure is equally applicable to tubes having one or more grids.

In a vacuous space a core of tungsten, molybdenum, or nickel is coated with a thin layer of nickel or copper and then superficially oxidised, for example in air. Subsequently, a tablet containing an alkaline-earth metal has this alkaline-earth metal separated from it by heating and decomposition of the azide and vaporised, this vapour being deposited on the oxidised nickel or copper layer and at last converted into oxide by a heating treatment of the core. The cathode thus obtained is brought into air and stored in air for 72 hours. Subsequently, the cathode is incorporated into the ultimate tube and heated so as to form a very thin layer consisting of one or a plurality of alkaline-earth oxides while inside the tube no traces of vaporised and deposited barium and, more particularly, no barium mirror on the wall is to be found.

What I claim is:

1. The process for manufacturing a cathode on a metal base of nickel oxide or copper oxide for an electric discharge tube, which comprises disposing the cathode base in a vacuous space, heating an alkaline-earth compound in that space to vaporize the alkaline-earth metal from the compound, and causing the earth-metal to precipitate from its vapor phase onto the metal base of nickel oxide or copper oxide, heating the core thus formed to convert the alkaline-earth metal to an oxide, then exposing that cathode element in an atmosphere containing carbonic acid to convert the oxide into a carbonate, incorporating the cathode in its intended operating position in the envelope of a discharge tube, and then heating the cathode to decompose the carbonate while evacuating the envelope.

2. A process as claimed in claim 1, wherein the cathode prepared in a separate vacuous space is exposed to air for at least 24 hours.

3. The method of manufacturing a cathode as in claim 1, which consists in limiting the thickness of the initial deposited layer of the vaporized metal to a thickness which will permit the final emissive layer to be formed with a thickness less than 10 microns.

4. The method of manufacturing an electron discharge tube that shall be free of an alkaline-earth metal mirror deposit on the wall of the tube and other surfaces, and so the tube may be suitable for short-wave use, which comprises the steps of forming the cathode by exposing a cathode supporting core in a vacuous space to a vaporized metal from an alkaline-earth compound to establish a layer of that metal on the cathode core; heating the core to produce a layer of the alkaline-earth metal oxide, exposing the core thus formed to an atmosphere of moist air to permit the oxide to be converted into the alkaline-earth metal carbonate, then incorporating the cathode element in that condition into the tube in which it is to function, heating the cathode to break down the carbonate to the oxide, and exhausting the tube.

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