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H. BIENFAIT

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METHOD OF MANUFACTURING ELECTRONIC TUBES WITH ACTIVE GETTERS

Filed July 20, 1946

Fig. 1.

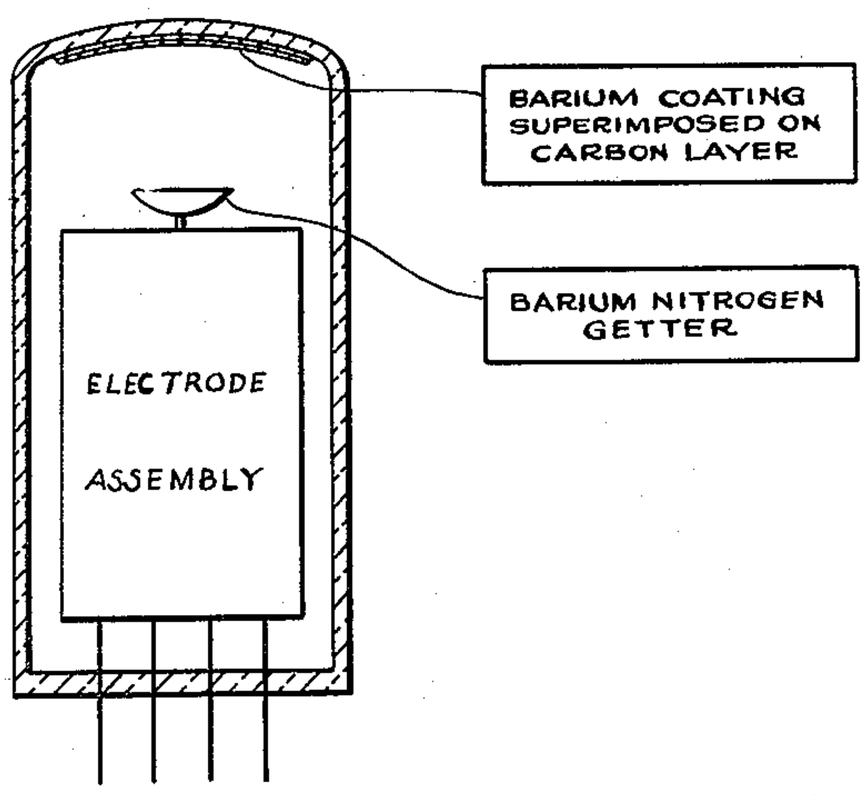
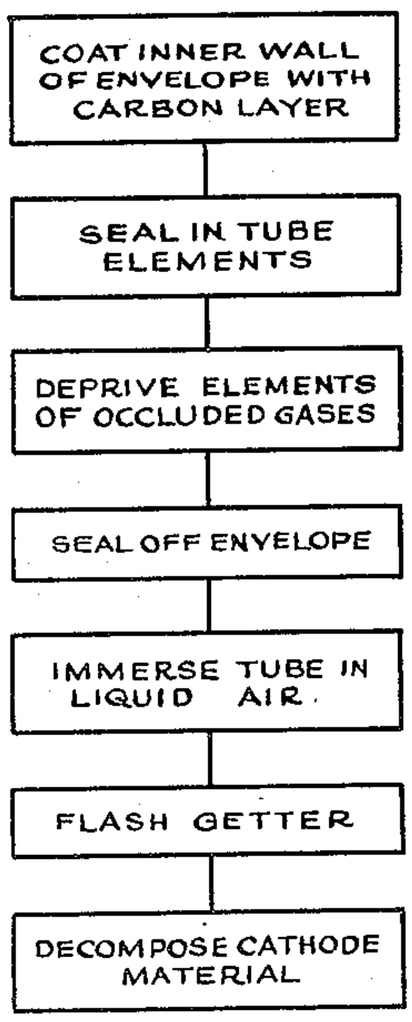


Fig. 2.



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METHOD OF MANUFACTURING ELECTRONIC TUBES WITH ACTIVE GETTERS

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6 Claims. (Cl. 316—25)

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This invention relates to a method of forming a highly active getter layer in vacuum spaces and to an electric discharge tube provided with such a layer.

In electric discharge tubes, such as receiver and transmitter valves and also cathode ray and X-ray tubes, and in other vacuum spaces in which base gases are liable to emanate after the sealing of the tube and have to be bound quickly, such as hollow resonators, rectifier valves filled with rare gas or the like, use is generally made of an active layer made of a metal operative to combine with gas, such as barium. Such a metal operative to combine with gases is not only known to be capable of combining with large amounts of gas during its volatilization, but even the layer formed by deposition of such a metal operative to combine with gas on a surface that may be conductive is so active as to be capable of combining with subsequently emanating gases.

The efficiency of such a layer is however largely dependent on the structure of the layer, that is to say on the manner of formation and on the nature of its surface. The lowest activity is possessed by a surface as smooth as a mirror and produced by slow volatilization of the active metal in vacuo. The activity is intensely increased if the metal combining with gas is quickly volatilized in known manner in a gaseous atmosphere constituted by rare gas, the rare gas being then pumped off. Instead of a rare gas a small quantity of a base gas such as carbonic gas, nitrogen or the like may be introduced into the vacuum space or be produced therein. After the tube is sealed the active metal is quickly volatilized, the quantity of gas present being bound. Obviously, the quantity should not be excessive. The metal is thus precipitated in the form of a black layer the surface of which is more or less spongy. A layer of this kind is capable of combining with comparatively large quantities of gas that may emanate while the tube is in use.

It is however important to increase the activity of such a layer as far as possible, because the larger the quantity with which the emanating gases are capable of combining, the lower is the mean gas pressure and hence the more satisfactory is the vacuum. Particularly with tubes in which much gas emanates while the tube is in use, such as transmission valves or tubes operating with very high voltages, such as X-ray tubes and high voltage rectifier valves, it is therefore important to increase the activity of the getter layer as far as possible.

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It is possible to produce an extremely active getter layer in vacuum spaces if in accordance with the invention the metal to be combined with the gas is quickly volatilized and is deposited on an artificially cooled surface which has previously been coated with a carbon layer. The volatilization is preferably effected in the presence of a non-excessive quantity of base gas, for example nitrogen, which may emanate during the volatilization of the active metal and then be again entirely bound during the deposition of the said metal. It has been found that the getter properties of an active layer are even improved several times over the above-mentioned well-known black layers, if the active metal is deposited on an intensely cooled surface. The activity can be further increased by about 50% by previously mounting a carbon layer on this surface. The surface is preferably cooled by means of liquid air or a freezing mixture. The metal combining with gas is preferably constituted by barium containing a certain amount of nitrogen. The low temperature of that part of the wall on which the metal is deposited and the presence of the carbon layer have apparently the effect of giving the active layer a very spongy surface the structure of which is exceedingly favourable for the getter action.

In discharge tubes a layer manufactured in accordance with the invention will preferably be mounted on a previously carbon-coated part of the tube wall, the bulb being immersed, during the volatilization of the barium, in a vessel containing liquid air or other freezing substance.

Owing to the fact that an active layer produced in accordance with the invention is capable of combining very quickly with unprecedented large amounts of gas entirely new possibilities of use are opened up.

Thus, for example, the invention is particularly useful in discharge tubes having very sensitive electrodes, such as for example tubes constructed particularly for being supplied from batteries. Tubes of this kind often comprise a very thin incandescent cathode which after the emanation of the emissive metal by the alkaline earth metal compound is liable to be poisoned even by small amounts of gas. Since during the decomposition of this alkaline earth metal compound, generally the carbonate, a great deal of gas emanates, this decomposition was always effected while the tube was still connected to the pump. Thus the cathode was liable to be impaired by the gases subsequently emanating during the deprivation of the electrodes of occluded

gases. The introduction of an active layer according to the invention into the tube now permits of the tube being sealed off the pump before the alkaline earth metal compounds applied to the cathode are decomposed. The tube is then immersed in a vessel containing liquid air or other freezing substance and the getter is quickly volatilized and deposited on the previously carbon-coated inner wall of the tube. The fact that the electrodes are only heated to a low extent while the tube is in use permits of the electrodes being deprived of occluded gases at a comparatively low temperature, the cathode being heated and the emissive compounds being decomposed after that. The gases thus emanating are quickly bound by the active layer provided on the tube wall.

Further, the invention is very useful for tubes, comprising secondary emission cathodes, for photo-electric cells and so forth, all of these tubes comprising electrodes which are highly sensitive to attack.

In order that the invention may be clearly understood and readily carried into effect, it will now be described more fully with reference to the appended drawing forming part of the specification and in which:

Fig. 1 diagrammatically illustrates a discharge tube made in accordance with the invention, and

Fig. 2 is a flow sheet showing a process in accordance with the invention.

As will be seen from Fig. 1, a discharge tube made in accordance with the invention comprises within an enclosing envelope, an electrode assembly of conventional form shown in block, and a barium nitrogen getter as above described. On the upper inner wall of the envelope a barium coating is formed, said coating being superimposed on a carbon layer previously deposited on the envelope wall.

After the inner wall of the bulb of an electric discharge tube is coated with a carbon layer, the electrodes mounted on a pinch or a flat bottom-disc are introduced into the bulb and sealed-in. After the electrodes and further parts of the tube are deprived of occluded gases by heating these parts to a high temperature, a source of barium, for example a pastil containing barium nitride, is cautiously heated and deprived of occluded gases. The tube is then sealed off the pump and its bulb is immersed in a vessel which contains liquid air and is surrounded by a high-frequency coil by means of which the barium nitride is decomposed and the barium quickly volatilized, so that it deposits on the carbon-coated inner wall of the bulb. Thereafter, the alkaline earth metal compounds applied to the cathode are decomposed. The foregoing steps are shown in Fig. 2 of the drawing.

What I claim is:

1. A method of manufacturing an evacuated bulb, comprising the steps of coating a surface portion within a bulb with a carbon layer, artificially cooling said coated surface portion, and quickly volatilizing a metallic getter within said bulb and depositing the volatilized getter on said cooled coated surface portion.

2. A method of manufacturing an evacuated bulb, comprising the steps of coating an internal wall portion of a bulb with a carbon layer, artificially cooling said coated wall portion, and quickly volatilizing an alkaline-earth metallic getter within said bulb and depositing the volatilized getter on said cooled coated portion.

3. A method of manufacturing an evacuated bulb, comprising the steps of coating a surface portion within a bulb with a carbon layer, artificially cooling said surface portion by liquid air, and quickly volatilizing a metallic getter within said bulb and depositing the volatilized getter on said cooled coated surface portion.

4. A method of manufacturing an evacuated bulb, comprising the steps of coating a surface portion within a bulb with a carbon layer, artificially cooling said coated surface portion, and quickly volatilizing a getter comprising a barium-nitrogen compound within said bulb to decompose said compound and depositing the volatilized barium on said cooled coated surface portion.

5. A method of manufacturing an evacuated bulb, comprising the steps of coating a surface portion within a bulb with a carbon layer, artificially cooling said coated surface portion and quickly volatilizing a metallic getter in the presence of a gaseous atmosphere within said bulb, and depositing the volatilized getter on said cooled coated surface portion.

6. A method of manufacturing a highly evacuated thermionic tube, comprising the steps of coating a surface portion within a bulb with a carbon layer, introducing within said bulb a thermionic cathode comprising alkaline-earth metal compounds, heating said alkaline-earth metal compounds within said bulb to decompose said compounds, cooling said surface portion, and quickly volatilizing a metallic getter within said bulb and depositing the volatilized getter on said cooled coated surface portion.

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