Sept. 1, 1936. H. M. LANG ET AL 2,053,090

PROCESS OF COATING AN ELECTRON EMITTER

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FIG. 1

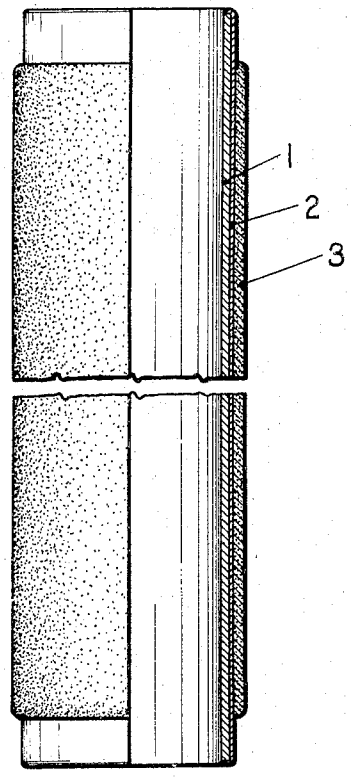
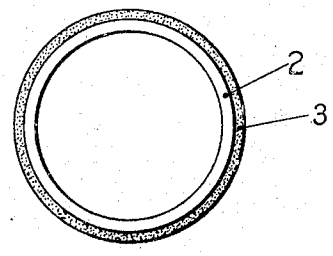


FIG. 2



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PROCESS OF COATING AN ELECTRON EMITTER

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1 Claim. (Cl. 250—27.5)

Our invention pertains to processes for coating metals and the products obtained thereby and relates to a novel process for coating metal to render and maintain a chemically clean surface therefor for subsequent processing to produce a new article of manufacture having improved characteristics for the purpose for which it is used.

Our novel process, as will be readily understood, may be used to produce many different products having many different uses requiring a maintained chemically clean surface for subsequent processing, but perhaps finds its chief use in the production of cathodes for thermionic tubes, as will hereinafter be particularly pointed out and discussed.

In the manufacture of coated cathodes for thermionic tubes, it has long been known that uniform and high electron emissivity and uniformity of product in manufacture might be attained if the surface of the metal upon which the electron emissive substances are placed was perfectly chemically clean, but it has been found impossible to maintain such surface in the essential chemically clean condition from the time the cleaning operation was terminated until the coating of electron emissive substances was applied. The wire of filamentary cathodes and the metal sleeves of cathodes of the indirect heated type, are, from the standpoint of economic cost of production, usually nickel, and if the chemically clean surface of nickel is exposed to the atmosphere for even an instant it begins to oxidize. Any degree of oxidation is disadvantageous as it increases the electrical resistance between the nickel and electron emissive substances and prevents the even distribution of heat to the electron emissive substances producing non-uniformity of product in manufacture, non-uniformity of emission, and loss of electron emissivity.

We have discovered, have proved and successfully demonstrated that if the metal to be cleaned and coated is, after passing through the cleaning and subsequent washing process, transferred, while a coherent film of the washing medium adheres uniformly thereto, to a plating bath and plated with a thin, uniform coating of a noble or other non-oxidizable metal, or a coating of any other coherent, non-oxidizable material which may be effectively applied while the cleaned surface is still covered by the film of washing medium, the surface is rendered and maintained chemically clean as no opportunity for oxidization thereof is permitted. The film of cleaning agent prevents oxidization while the object is in transit from the cleaning process to the washing process and the coherent film of washing medium prevents oxidization while the object is in transit from the washing process to immersion in the plating or coating process. We have discovered that when such a coating is applied to a metal, such as for instance nickel, and subsequently coated with electron emissive substances well known in the art, such as barium and strontium carbonates, and thereafter heated in the exhaust process of fabricating a thermionic tube, the electroplated film or other coherent coating disappears in some manner not fully understood, if metal, either by combining with or sinking into the nickel or the electron emissive substances, and, if organic material, it volatilizes without residue and is removed during the exhaustion process. In any event, it permits of a low electrical resistance bond being effected between the nickel and electron emissive substances and one in which the thermal conductivity is uniform throughout the area thereof, and at the same time facilitates the amalgamation of the radio-active material in the electron emissive substances with the surface of the chemically clean nickel sleeve, which results in a cathode having extremely uniform emission characteristics in mass production and one having approximately 50% higher electron emissivity than those now in general use.

One of the principal objects of our invention comprises the provision of a process for producing a coating for metals rendering and maintaining a perfectly chemically clean surface therefor for subsequent processing requiring such surface.

Another object comprises producing a new article of manufacture having a maintained chemically clean surface for subsequent processing.

A still further object comprises the provision of a cathode for thermionic tubes having uniform thermionic characteristics and maximum electron emissivity.

We accomplish all of the above noted desirable objects and features and others which will later herein be apparent, by the process hereinafter described with respect to the drawing accompanying and forming a part of this specification and in which:

Fig. 1 is a greatly enlarged, broken, partially sectioned view of a thermionic cathode of the indirect heated type constructed in accordance with our process, and

Fig. 2 is a plan view of the same.

In order to fully disclose our novel process we

deem it advisable to describe the process as used to produce an improved article of manufacture such as an indirect heated cathode for thermionic tubes as illustrated in the Figs. which show two greately enlarged views of such a cathode before the same has been subjected to the heating, bombarding and degasifying process used in the fabrication of thermionic tubes.

Referring now particularly to Fig. 1, we produce an article, such as the cathode shown, by subjecting the nickel sleeve 1 to the usual well known cleaning process whereby all forms of contamination such as grease, oil, human skin acids, and all forms of oxides and sulphides, are removed to attain a perfectly chemically clean surface for the article or metal being processed. If desired, the sleeve may be subjected before cleaning to the usual hydrogen annealing process, also well known in the art for the purpose of facilitating the subsequent degasification of the metal. After being chemically cleaned and while a protective coating of film of the cleaning material still completely covers the sleeve it is removed from the cleaner and submerged in and washed in a washing medium, for example, running water, to remove all traces of the cleaner and after thus being completely freed of cleaner is, while a coherent film of the rinsing medium adheres and completely covers the chemically clean surface, transferred to an electroplating bath and plated with a deposit of rhodium, gold, or other non-oxidizable metal 2 which completely covers the chemically clean surface with a permanent, coherent, film of the non-oxidizable metal which is at normal temperatures gas-impervious.

Any other non-oxidizable material either organic or inorganic may, of course, be used, provided, however, that it is of such nature that it can be applied to the chemically clean surface without removal of the protective film of rinsing medium or disruption of the continuity of such film. After the permanent protective coating has been applied, the sleeve may be, if desired, stored for future use and may at any subsequent time be coated with the usual electron emissive substances such as a combination of barium and strontium carbonates as shown in Fig. 1 in which the permanent protective coating 2, exaggerated as to thickness, is shown between the chemically clean surface of the nickel 1 and the electron emissive coating 3.

We have discovered and successfully demonstrated that when a thermionic cathode is prepared as above described and subsequently heated in the process of degasifying a thermionic tube the protective film, if metal, disappears in some way not fully understood either by dissolving or sinking into the nickel or combining with the nickel or the electron emissive substances and, if organic, volatilizes without residue and is removed by the exhaust pumps. By our process the electron emissive substances are bonded to the chemically clean surface of the nickel in a manner which results in an efficient and effective electrical and thermal bond producing a cathode which has uniform electron emissive characteristics in production and one which has approximately 50% higher electron emissivity.

We have found that the continuity of the film of rinsing medium must not be disturbed or broken and must at all times completely cover the chemically clean surface of the metal from the time such surface has been cleaned until the permanent protective coating is substituted therefor, because in experiments which we have conducted in which the surface has been dried after washing and even when the sleeves are placed in hermetically sealed containers, it has been found that when electron emissive substances are thereafter applied to such sleeve, the resultant cathode is no more efficient in uniformity of emission or in emissivity than those now in common use.

While we have described our novel process as used to produce a new and efficient type of thermionic cathode, it is to be thoroughly understood that our process is not limited to such and may be used for the production of a rendered and maintained perfectly chemically clean surface for any metal object requiring such surface for subsequent processing, to produce an article of manufacture having improved characteristics for the purpose for which it is used.

Having thus completely described our invention, what we claim as new and desire to secure by United States Letters Patent is as follows:

The method of producing a highly efficient electron emissive surface for a metal which comprises, chemically cleaning the surface of the metal, washing the metal with washing fluid until all traces of cleaning medium are removed, maintaining during and after the washing operation a uniformly coherent protective film of washing fluid on said metal to protect the surface of said metal from oxidization and contamination, substituting for said film a coherent coating of a non-oxidizable, normally gas impervious material on said metal without previous disturbance of the uniform continuity of said protective film, applying a coating of electron emissive substances on said non-oxidizable coating and finally subjecting said metal to a heating operation whereby said non-oxidizable coating is caused to disappear and said electron emissive substances are, because of the maintenance of the surface of said metal free from oxidization and contamination by said protective film, efficiently and effectively electrically and thermally united with said metal.

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