

June 20, 1933.

E. L. KOCH

1,914,432

CATHODE COATING PROCESS

Filed April 9, 1926

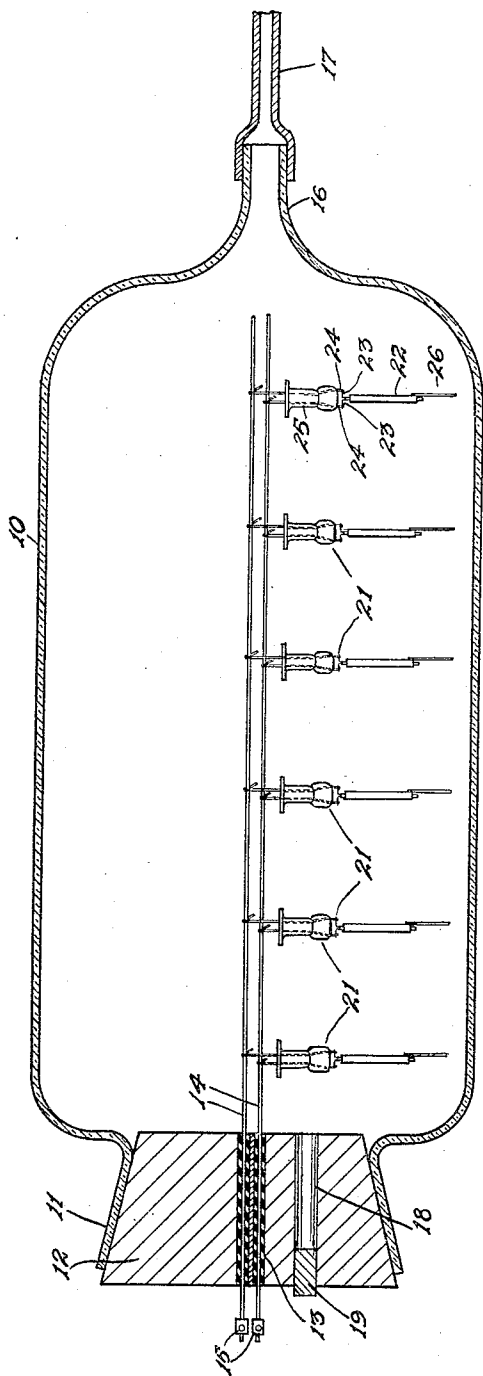


Fig. 1.

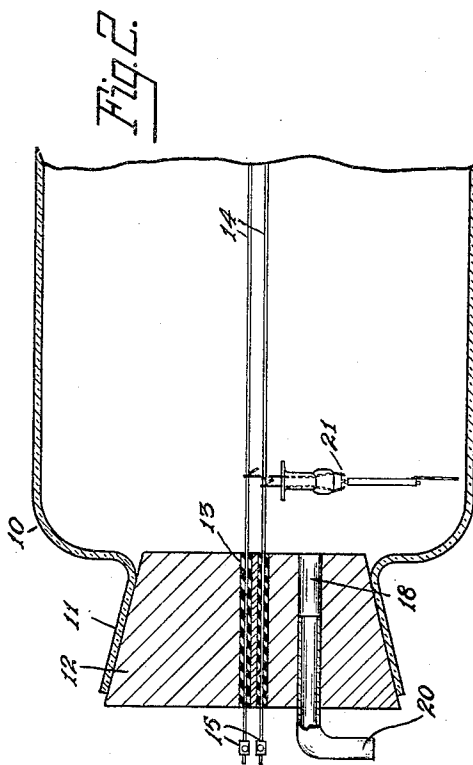


Fig. 2.

Inventor:
Earl L. Koch
By S. A. Ganshouski.
Attorney.

UNITED STATES PATENT OFFICE

EARL L. KOCH, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

CATHODE COATING PROCESS

Application filed April 9, 1926. Serial No. 100,896.

This invention relates to a process for coating metals with oxides or other metallic salts, such as oxides or salts of barium and strontium, etc., to provide an electron emitting source.

It has heretofore been thought to be impractical to attempt to coat with oxides, metals other than those of a non-oxidizable nature as platinum for electron emission purposes. This is due to the fact that a thin layer of oxide is formed on the surface of the metal during the decomposition of the electron coating substance. This layer of oxide between the metal and the coating substance acts as an insulator causing the emitting substance to be substantially entirely insulated from the metal base.

The object of the present invention is the provision of a process whereby metals having fairly high melting points, such as molybdenum, nickel and the like, may be used successfully as the base for the application of electron emitting oxides.

In carrying out the present process, a solution of barium, or strontium salts, or the like, is applied to the base metal of the cathode and is then decomposed in an atmosphere of carbon dioxide (CO_2) or other suitable gas, care being taken during the decomposing process to maintain the temperature of the cathode just below the oxidizing point of the base metal. If the process is carefully controlled, the coating mixture may be applied and decomposed without causing a film of oxide to form on the metal between the metal and the electron emitting coating.

In carrying out the present process, it is desirable to remove from the base metal of the cathode the gases contained therein by occlusion, before decomposing the electron emitting coating. This may be accomplished by heating the cathode structure in an atmosphere free from oxygen as hydrogen or in a substantial vacuum.

It is believed the further disclosure of the invention will be most readily understood from a detailed explanation of the process, step by step, in connection with the apparatus for carrying it out shown in the accompanying drawing, in which:

Fig. 1 is a view of a container in section showing a plurality of cathode structures therein arranged for carrying out the process of the present invention, and

Fig. 2 is a view of a portion of apparatus similar to that of Fig. 1, but shows a tube connecting with the top of the container through which may be supplied the hydrogen during the cleaning process or carbon dioxide during the decomposing process.

Referring now to the drawing in which like reference characters indicate the same parts in the different views, 10 indicates a container or cylinder of glass or other suitable material having at the upper end thereof the tapered neck 11. Fitting in air tight relation to the neck 11 is the closure or stopper 12 of any suitable material. Extending through the insulating sleeves 13 in the stopper 12 is a pair of conductors 14 provided at the upper ends thereof with the terminals or binding posts 15. The container 10 is reduced at its lower end, as shown at 16, and has associated therewith the pipe or tube 17 which may extend to an air pump or other desired apparatus. The stopper 12 is provided with an opening 18 therethrough which opening may be closed with a stopper 19, as shown in Fig. 1, or may have associated therewith a pipe 20, as shown in Fig. 2, through which hydrogen, carbon dioxide, or other gas, may be supplied to the container 10 for the purposes to be hereinafter set forth.

Positioned within the container 10 is a plurality of cathode structures indicated generally by the reference character 21. These cathode structures are of the type in which a metal sleeve or shell 22, which forms the cathode proper, is provided with a core of porcelain or other suitable material, within which is a loop of resistance wire for heating the cathode proper, the ends 23 of which are joined to the leads 24 extending through the auxiliary stem 25. The leads 24 extend beyond the stem 25 and are joined, respectively, to the wires or rods 14. At 26 is indicated the conductor or lead, which, in the completed tube forms one link in the electrical path joining the cathode shell to its terminal contact pin projecting from the base of the tube.

A cathode structure of the general character of that herein schematically indicated is more fully disclosed in an application of Frederick S. McCullough, Serial No. 12, 477, filed March 2, 1925.

As above explained, in carrying out the present process, it is found desirable to first remove the gases from the cathode structure by heating it in an atmosphere substantially devoid of oxygen and then continue the heating process in an atmosphere of carbon dioxide or other inert atmosphere agent. Assuming that the cathode structures 21 have been connected to the wires or rods 14, as above explained, the cathode coating process will be carried out substantially as follows: The sleeves or shells 22 will first be coated with a solution of the salts of barium and strontium, or other appropriate metallic salts, the oxides of which form an efficient electron emitting substance. Having coated the cathode shell 22, as just explained, the stopper 12 will be inserted in the neck 11, as shown in Fig. 1. In carrying out the next step, the air may be evacuated from the cylinder 10, or the cylinder may be supplied with some gas devoid of oxygen, as hydrogen. Assuming that the first procedure is to be followed, the pipe or tube 17 will be connected with an air pump and the air substantially exhausted from cylinder 10. The terminals 15 will now be connected to a source of alternating or other appropriate voltage; thus causing current to flow through the resistance elements within the cathode shell 22. This acts to heat the porcelain core and shell 22 and drives off the gases contained therein, it being understood, of course, that the gases will be removed from the cylinder 10 as they are driven out of the cathode structures during the cleaning up process just referred to.

When the gases have been sufficiently driven off from the cathode, the cylinder 10 will have supplied thereto, as through the tube 20, an atmosphere of carbon dioxide or other inert atmosphere, the heating of the cathode shell being continued; thus effecting a decomposition of the barium, strontium, or other salts contained in the mixture or solution applied to the cathode shell. In carrying out this process, it is desirable that the temperature of the cathode be maintained just below the point at which the metal of the shell 22 will oxidize. By exercising care in controlling this process, the coating mixture may be applied to the cathode shell and decomposed to its oxide without causing a film of the oxide of base metal to form between the electron emitting coating and the cathode sleeve, even when metals which are fairly readily oxidized, such as nickel, molybdenum and the like are employed.

While in the drawing but a single type of cathode structure is shown and the process is herein described as carried out with this type

of cathode, it is to be understood that the process may readily be employed with cathodes of types differing radically from that herein shown. The invention, therefore, should be limited only by the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The process of coating a cathode base metal with a layer of electron emitting oxides which consists of applying to the base metal a solution of salts to be decomposed, placing the cathode in a container, evacuating said container and removing occluded gas from said cathodes, then admitting carbon dioxide to the said container and heating the said base metal to a temperature just below its oxidizing point to decompose the salts to oxides.

2. The process of coating an oxidizable cathode base metal with a layer of electron emitting oxides which consists in applying to the base metal a solution of the salts of the metals to be decomposed, placing the cathode structure in a container, removing substantially all oxygen from said container, heating the cathode structure to drive off the gases therein, supplying said container with an atmosphere of carbon dioxide and heating the cathode to effect the decomposition of the salts of the metals of the said solution, the temperature of the cathode structure being maintained just below the oxidizing point of the base metal.

In testimony whereof I have signed this specification.

EARL L. KOCH.