Dec. 1, 1942. A. H. TOEPFER 2,303,515

METHOD AND APPARATUS FOR CONSTRUCTING MAKE-ALIVE ELECTRODES

Filed May 7, 1942

Fig. 1.

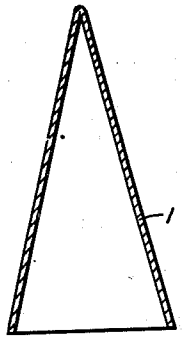


Fig. 2.

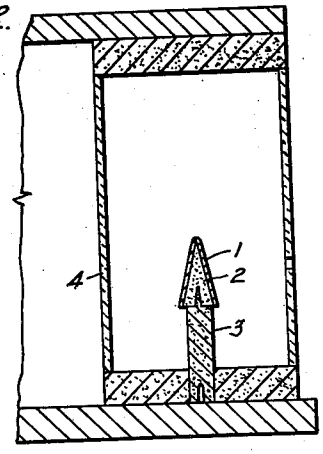


Fig. 3.

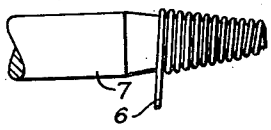


Fig. 4.

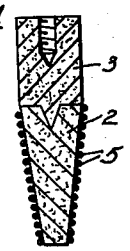


Fig. 5.

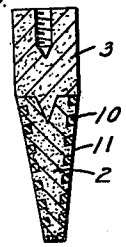
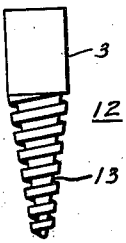


Fig. 6.



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METHOD AND APPARATUS FOR CONSTRUCTING MAKE-ALIVE ELECTRODES

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7 Claims. (Cl. 250—27.5)

The materials heretofore found most suitable for use as make-alive electrodes are generally hard abrasive materials such as boron carbide or silicon carbide and the construction of suitable make-alive shapes has been extremely difficult. The best method heretofore discovered for producing these shapes has been to shape a carbon or graphite rod to the desired shape of the final electrode and then convert the graphite material in an electric furnace to a substantial boron carbide composition. However, a great many blanks are spoiled in the manufacturing operation and other unforeseeable difficulties produce undesirable electrodes so that it is necessary to discard a great many apparently finished electrodes to secure the desired uniformity of the electrodes actually put in service.

It has heretofore been proposed to construct the electrodes of relatively finely divided make-alive material held together by suitable binders but the extremely fragile nature of the originally molded electrodes has militated against such construction.

Since it is desirable to heat-treat the make-alive electrodes at a relatively high temperature, I have discovered that the electrodes can be formed in relatively thin metal molds shaped either by drawing sheet metal blanks or by winding up a strip material such as wire on a suitable form, mold the material within the form, attach a suitable conducting head preferably of graphite, and heat-treat the material within the form itself, finally raising the temperature above the melting point of the metal, such as iron or steel usually utilized for the form, and removing the form by melting it away. This method produces extremely uniform electrodes, both as to physical dimensions and electrical characteristics.

It is therefore an object of my invention to provide a simple method of forming make-alive electrodes.

It is a further object of my invention to provide an electrode having uniform physical dimensions and electrical characteristics.

It is a further object of my invention to provide an electrode mold which can be removed when melting the same from the sintered electrode.

Other objects and advantages of my invention will be apparent from the following detailed description, taken in conjunction with the accompanying drawing, in which:

Figure 1 is a sectional elevation of a sheet metal mold according to my invention;

Fig. 2 is a sectional elevation through a heat-treating furnace showing the application of my invention to the construction of an electrode;

Fig. 3 is a plan view showing the method of constructing a mold from strip material;

Fig. 4 is a cross-sectional elevation showing the utilization of the wound mold form;

Fig. 5 is a similar view of a modification of the strip mold according to my invention, and

Fig. 6 is an elevational view of a make-alive electrode constructed according to my invention.

In the embodiment of my invention according to Figs. 1 and 2 of the drawing, a piece of sheet metal is drawn or otherwise shaped to provide a mold 1 having an interior of the shape desired for the finished electrode. The mold 1 is then filled with a composition 2 of make-alive material such as powdered boron carbide or silicon carbide held together with a suitable binder, preferably an organic material of the hydrocarbon group. I have found that materials such as sugar and starches are particularly suitable as a binder material.

In order to attach a head 3 or conducting connector to the make-alive body 2, a head 3 is constructed of suitable conducting material such as graphite, and pressed into firm contact with the material 2 filling the mold. The mold 1 and its assembled material is then placed in a suitable furnace 4 preferably of the electric arc type in a non-oxidizing atmosphere and sintered at a temperature of the order of 1200° C., or over, which carbonizes the binding material and firmly bonds it to the conducting connector 3 while this temperature removes the mold metal by reducing it to a fluid which drains away, leaving the finished electrode unchanged from the shape of the original mold cavity. The resulting electrodes have been found to have very desirable physical characteristics in that they are tough, and hard, and have the desired shape without further grinding or mechanical treatment. Also, because of the uniformity of shape and construction the electrical characteristics have been found much more uniform than in hereofore constructed devices.

Instead of constructing the mold 1 from a sheet material, a mold 5 may be constructed from strip material such as wire by winding the same on a mandrel 7. The wire mold 5 is filled with the make-alive material 2 in exactly the same manner as the drawn mold 1 is filled and treated in the same manner to properly sinter and bond the make-alive electrode and melt away the wire mold 5.

I have also found that when utilizing a wire mold 5 the material 2 can be sintered for several minutes at a temperature below the melting point of the wire material to harden the material 2 and the wire material 6 may then be stripped from the semi-finished electrode which is then heat-treated at the higher temperatures to secure the necessary hardness and electrical characteristics. This latter method is particularly suitable when a metal such as aluminum or copper is utilized for the mold material 6, as these metals tend to contaminate the make-alive electrode when the sintering temperature is raised above the melting point of the metal. However, when non-contaminating materials such as iron or steel are utilized for the mold material 6, I prefer to melt the wire from the electrode rather than remove it in a prefinished state.

A further advantage of the wound mold 5 lies in the fact that the individual coils 10 of the form 5 may be separated a suitable distance 11 and the make-alive mixture 2 is pressed, not only into the interior of the form 5, but into the interstices 11 between the windings 10, so that when the electrode 12 is finished, it will present an exterior surface having a spiral groove 13 for reducing the operating current as disclosed in Slepian Patent No. 2,246,326.

It will thus be seen that I have provided a cheap and readily utilized form for providing molded electrodes of any desired shape or physical dimension and also a form that can be readily removed without destroying the molded material.

While, for purposes of illustration, I have shown and described specific embodiments of my invention, it will be apparent that changes and modifications can be made therein without departing from the true spirit of my invention or the scope of the appended claims.

I claim as my invention:

1. The method of constructing a make-alive electrode which comprises winding a strip metallic material to provide a mold having a mold cavity conforming to the desired shape of the finished electrode, filling the mold cavity with particles of high resistant material and an organic binder material, securing a graphite head to said filling and heat treating the assembly at a temperature above the melting point of the mold.

2. The method of constructing a make-alive electrode which comprises winding a strip metallic material to provide a mold having a mold cavity conforming to the desired shape of the finished electrode, filling the mold cavity with particles of high resistant material and an organic binder material, securing a graphite head to said filling, sintering the combination at a temperature below the melting point of the metallic material and then heat treating at a temperature above the melting point of the metallic material.

3. The method of constructing a make-alive electrode which comprises constructing a metallic mold, filling said mold with a mixture of high resistive material and a binder, and heat treating said mixture at a temperature above the melting point of the metal mold.

4. The method of constructing a make-alive electrode comprising the steps of producing a thin-walled ferrous metal mold having a mold cavity corresponding to the desired shape of the electrode, filling the mold cavity with a paste composed of boron carbide particles and an organic binder, pressing a graphite head into said mixture and heating treating said electrode at a temperature of the order of 1200° C. for a period of the order of three hours.

5. The method of constructing a boron carbide electrode which comprises constructing a substantially conical metal mold, filling said mold with a paste composed of boron carbide and a hydrocarbon binder, assembling a conducting head in contact with said paste and melting the metal mold from the assembly in a non-oxidizing atmosphere.

6. The method of constructing a make-alive electrode which comprises winding a metallic strip into a mold, filling said mold with a mixture of high resistant material and an organic binder, pressing a conducting head into contact with said filling and sintering said assembly in a non-oxidizing atmosphere at a temperature above the melting point of the metallic strip.

7. The method of assembling a high resistant electrode which comprises spirally winding a metallic strip into a substantially conical mold, filling the mold with a mixture of finely divided boron carbide and a hydrocarbon, assembling a graphite head in contact with said mixture and sintering the assembly at a temperature of the order of 1200° C.

ADOLPH H. TOEPFER.