May 9, 1933. H. M. KRANER 1,907,984

ELECTRODEPOSITION OF PORCELAIN

Filed April 23, 1930

Fig. 1.

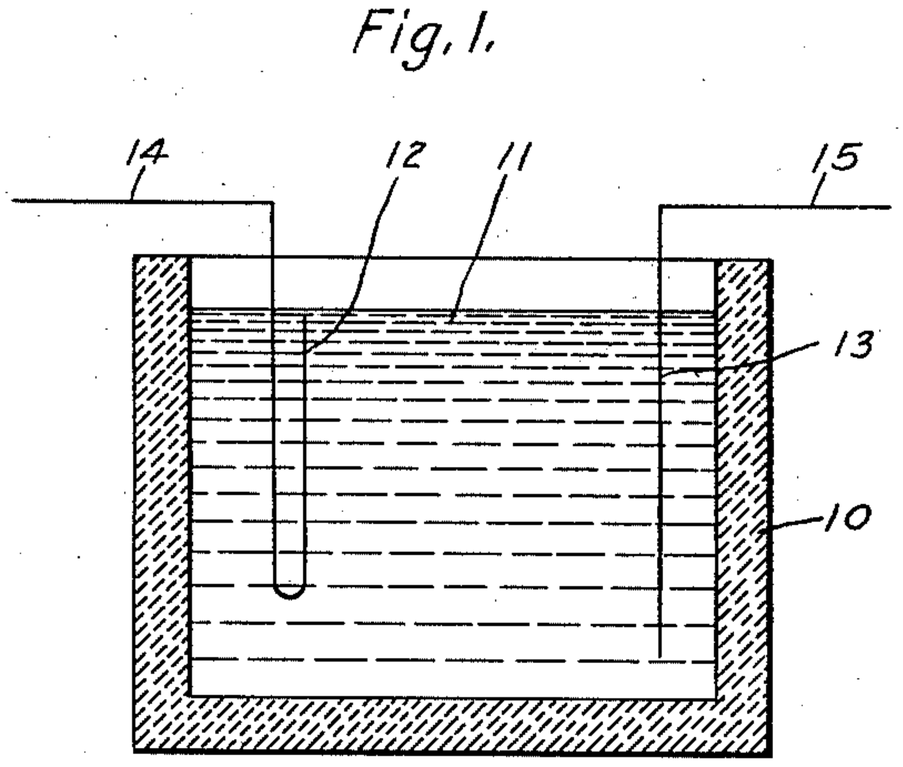

Fig. 3.

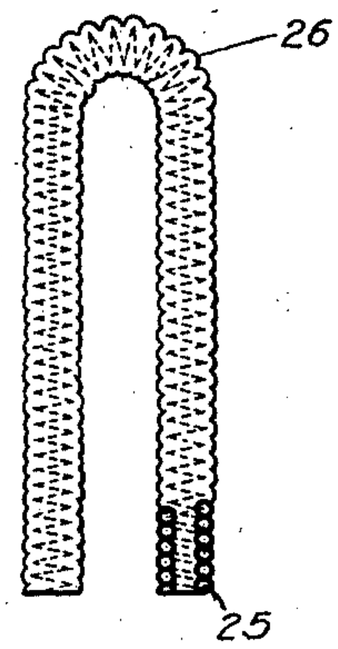

Fig. 2.

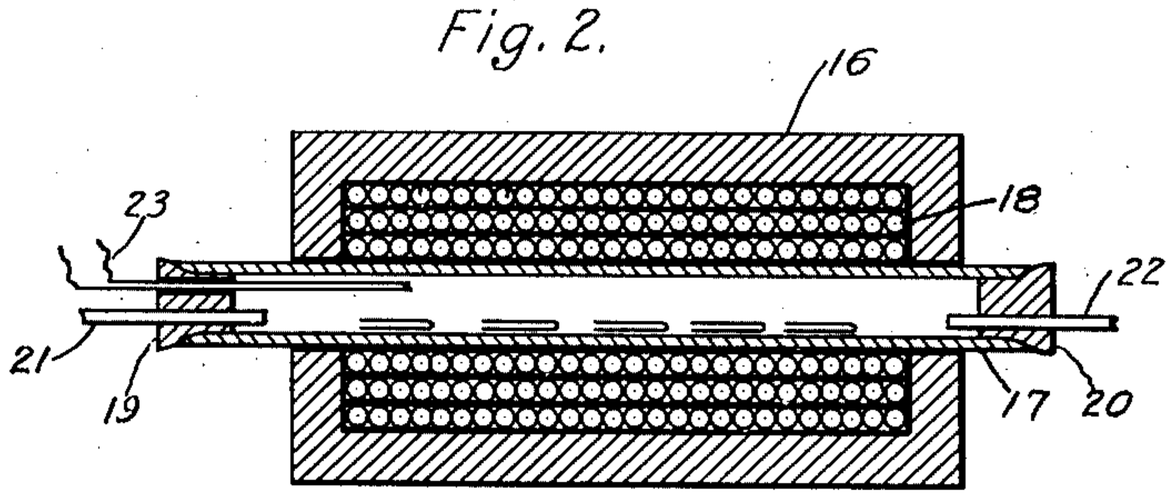

Fig. 4.

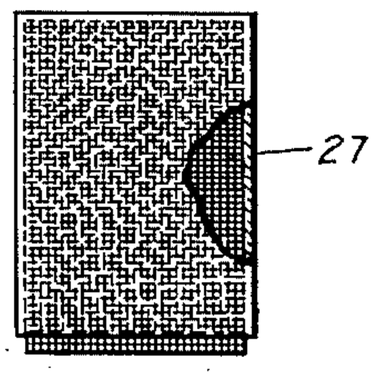

Fig. 5

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UNITED STATES PATENT OFFICE

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ELECTRODEPOSITION OF PORCELAIN

Application filed April 23, 1930. Serial No. 446,512.

My invention relates to insulated objects and especially to the method of coating such objects with porcelain.

The invention has particular relation to the coating of the elements of thermionic tubes with an insulating coating of porcelain. It has hitherto been customary, in coating the elements of thermionic tubes with porcelain, to spray the porcelain on the elements and, after drying the same to again spray and dry until the desired thickness of coating was obtained. The elements were then fired in the furnace. This method of spraying has often resulted in the object being unevenly coated and, furthermore, considerable time and care is required to provide a coating of the desired thickness.

According to my invention, I deposit the porcelain on the element by an electrolytic process and then fire the same in a furnace of any suitable type. By this means the length of time for depositing the porcelain can be accurately determined by experience, so that a coating of the desired thickness will automatically be deposited upon the metal element without the careful supervision heretofore exercised. Furthermore, the time of depositing the porcelain can be made of the order of a few seconds instead of the order of minutes with the spraying process.

Fig. 1 is a cross section through a bath illustrating the application of the porcelain to the metal object,

Fig. 2 is a cross section through a preferred type of furnace for firing the porcelain-coated object.

Fig. 3 is an elevation of a porcelain-coated coiled wire.

Fig. 4 is an elevation of a porcelain coated screen.

Fig. 5 is still another elevation of a porcelain-coated hook to be used in thermionic tubes.

In Fig. 1 is disclosed the container 10 having a bath 11 therein. Submerged in the bath 11 is the metal object 12 which is to be coated. An electrode 13 is also placed in the bath at a suitable distance from the metal object 12. The object 12 and electrode 13 are connected, by the terminals 14 and 15, to a source of electricity.

The bath 11 is composed of a refractory clay mixture. This mixture is composed of clay and other ceramic materials suspended in water. Various mixtures may be used, depending upon the degree of refractoriness desired. Mullite, alumina, zircon, zirconi, talc, andalusite, sillimanite, and quartz are some of the non-plastic minerals which may be used in combination with the clay. These non-plastics do not shrink in the firing, while a plastic clay would shrink in the firing. A mixture containing 1% clay and 99% alumina would deposit electrolitically if prepared with only sufficient water to suspend the alumina. In general, however, it would probably be preferable to use a greater percentage of clay, such as 10% clay and 90% alumina. A mixture of 50% clay and 50% alumina would not be as refractory as the 10% clay and 90% alumina. If desired, mullite could be substituted for the alumina in the above proportions. The composition of mullite is $3Al_2O_3.SiO_2$. The composition of clay is $Al_2O_3.2SiO_2.2H_2O$. The addition of an electrolyte, such as Na_2CO_3, assist the process but is not absolutely necessary.

The current passing through the electrolitic bath 11, between the electrodes 13 and the object 12, will deposit the porcelain upon the object 12. Experience with the voltage, type of bath, current density and spacing between the electrodes will determine how long the object shall be immersed in the bath in order to obtain the desired thickness of coating. By way of example, and not in a limiting sense, a wire placed in a container two inches in diameter and with a voltage drop of 30 volts across the electrodes deposited a satisfactory coating in about 5 or 6 seconds. After the period of time has once been determined, it is apparent that the object may be placed in the bath and then removed at the proper interval of time. It is also apparent that other filaments may be placed in the bath during this time interval. If desired, the immersion of the object in the bath for the desired interval of time could be made by automatic time-controlled machinery.

After the metal object has been coated in the electrolitic bath of Fig. 1, it is placed in a furnace and fired. This furnace may be of the electrical type shown in Fig. 2, with its outer casing 16 enclosing an inner hollow tube 17. The inner tube 17 has a plurality of electrical wires 18 surrounding its center portion in good thermal conductivity therewith. Current passing through the wires 18 provides sufficient heat to make the interior of the tube very hot and preferably of the temperature in the neighborhood of 1150° C. Plugs 19 and 20 close both ends of the tube after the objects 12 have been placed therein. It is preferred to have conduits 21 and 22 in these plugs for the purpose of introducing a gas, such as hydrogen into the furnace during the firing process. A thermal couple 23 also preferably extends into the furnace to indicate the temperature inside of the tube 17.

This process of electrolytically depositing porcelain is especially adapted to the coating of thermionic elements, such as the heater wire disclosed in the copending application of William J. Kimmell, Serial No. 428,637, filed March 15, 1930. Other coiled wire, such as 25 in Fig. 3, may be coated with an insulating coating of porcelain 26. Screens 27 may be also coated with porcelain, as disclosed in Fig. 4.

The process can also be applied to the hook 28 disclosed in Fig. 5 for insulatingly supporting the filament of a thermionic tube. It is obvious that the process could also be applied to the coating or forming of various other objects with porcelain.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. The method of insulating a wire element of a thermionic tube which comprises electrolytically depositing a refractory clay mixture on said wire element and firing said clay mixture.

2. The method of insulating a wire element of a thermionic tube which comprises electrolytically depositing a refractory clay mixture on said wire element and firing said clay mixture in an atmosphere of hydrogen.

3. The method of insulating a wire element of a thermionic tube which comprises placing said wire element in a refractory ceramic mixture containing plastic and non-plastic materials, electrolytically depositing said materials upon said wire element and firing the deposited materials upon said wire.

In testimony whereof, I have hereunto subscribed my name this 18th day of April, 1930.

HOBART M. KRANER.