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METALLIC COATING

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This invention relates as indicated to metallic coatings and more particularly to thin adherent metallic coatings applied to a metallic base by a firing operation.

There are many types of commercial articles which require the provision of a decorative or protective metallic coating and which for various reasons do not conveniently permit the use of electrochemical means for the production of such coating. A notable example of such a case is where the finished article is to comprise the combination of a fired vitreous enamel coating and a metallic protective or decorative coating in different areas on the surface of the article. It will be quite evident that in such cases there will be a considerable advantage in being able to simultaneously produce both the non-metallic and the metallic coatings in a single firing operation.

While my invention is thus capable of use to a great advantage in the production of composite coatings, the invention is not limited to such embodiments since my invention may be advantageously employed in the production of a protective or decorative coating which extends over the entire surface of the article.

It is a principal object of my invention therefore to provide a process of producing a protective or decorative thin metallic coating which may be provided by a firing operation rather than by electrochemical means. Other objects of my invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described, and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative however, of but a few of the various ways in which the principle of the invention may be employed.

Broadly stated, this invention comprises the production of thin adherent decorative or protective metallic coatings on metallic bases by depositing a coating on such base which contains both the protective coating metal and a suitable flux and then firing the coating under proper conditions in a reducing atmosphere.

The metals which may be used as the protective coating metals are preferably nickel, cobalt or chromium, these generally being preferable for use in the order in which they have been named. Copper, zinc, tin and lead may also be employed although the films produced by such metals are generally not as adherent as are those metals of the class first enumerated.

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All of the metals thus far enumerated are preferably applied in the form of an oxide of them. The oxide is admixed with a suitable flux hereinafter more particularly defined and in the proportions given and then fired in a reducing atmosphere in accordance with the particulars presently to be explained. Instead of using the oxide as the source of the protective coating metal, I have also found that aluminum metal as such may be used either alone or in combination with any one or more of the oxides of the metals previously named.

While the oxides of nickel, cobalt and chromium have been indicated as capable of producing the best coatings from the standpoint of adherence, nevertheless such oxides may be employed in conjunction with the oxides of copper, zinc, tin and lead and entirely satisfactory coatings produced so long as the oxides of nickel, cobalt and chromium are present in the majority amount. Thus, it will be observed that the coatings which are capable of production by my invention may consist of one or a combination of two or more of any of the previously named metals, provided that the metals nickel, cobalt or chromium, or combinations of them, are present in the major amount.

The factor which determines the particular combination of metals to be used will depend upon the character of the use as well as the decorative effect desired.

The metal bases to which my improved coatings may be applied will preferably consist of iron or steel.

The metal or oxide thereof is applied to the work to be coated in admixture with a suitable flux. The fluxes which have been found useful include borax, sodium nitrate, magnesium chloride, or combinations of two or more of such named fluxes. These fluxes are capable of use in concentrations of 1 to 6 parts of the flux to 100 parts of the metal oxide.

I have found however that from 1 to 10 parts of the flux may be employed in combination with 100 parts of the oxide if the former is a conventional lead borosilicate glass smelted for example from a raw batch mixture which comprises leads oxide 795 parts, boric acid 190 parts, and silica 15 parts.

The admixture of the metal or metal oxide and the flux is preferably accomplished simultaneously with the grinding of the same, as for example in a conventional ball mill used in grinding porcelain enamel slips and the like. The components, i. e. the metal oxide, the flux, and water,

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are placed in the mill in about the following proportions: Metal oxide 100 parts, water 36 parts, flux 1 to 10 parts depending upon the particular flux used as above explained. It is desirable that the metal or metal oxides selected for use be of such fineness before milling that substantially all will pass through a 200 mesh sieve. The milling operation is continued for a period from 16 to 24 hours, at the end of which time all of the components will be in an extremely finely divided state.

The milled intimate mixture is then applied onto clean iron or steel which has been previously freed from all oxide and rust by conventional pickling and/or cleaning operations. The coating may be applied either by spraying or painting and after being thus applied will be dried by a normal drying procedure such as employed in drying porcelain enamel coatings on metallic articles prior to firing.

The coating should be applied to the metal base thinly and evenly so that its dried weight is on the order of from 4 to 12 grams per square foot, 8 grams per square foot of dried weight of application will generally produce best results.

After the coating has thus been applied and dried, it will be placed in a muffle and fired at a temperature of 1550° F. for a period from 15 to 45 minutes depending upon the particular oxide which has been used for the purpose of providing the decorative or protective finish coating. When chromium oxide is employed to yield a chromium coating, the firing time will be approximately 45 minutes. Nickel oxide will require a firing time of about 30 minutes, and a combination of about equal parts of nickel and zinc oxide will be fired out satisfactorily in about 15 minutes.

The firing operation is performed in a closed system, preferably in an electric furnace and necessarily in a reduced atmosphere. The reducing atmosphere may be provided by filling the electric furnace with illuminating gas. While when initially charged the illuminating gas will burn in the furnace, it will nevertheless presently consume all of the available oxygen in the furnace and thereafter provide a full reducing atmosphere.

At the end of the firing period, the work is removed and permitted to cool at a normal rate to room temperature, and when cooled it will be found to contain a surface discoloration which may be removed by simply buffing or by a preliminary weak acid wash followed by buffing. The buffed finish has a high lustre with a characteristic appearance of the metal of which it is formed and provides an entirely satisfactory decorative and protective finish for the purposes previously explained.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:

1. The method of producing a thin adherent metallic coating on the surface of a metallic base which comprises providing a mixture of a flux, a major proportion of at least one oxide of a metal of the group consisting of nickel, cobalt and chromium, and a minor proportion of at least one

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oxide of a metal of the group consisting of zinc, tin, and lead, the particles of said mixture being of such fineness that substantially all will pass through a sieve having 200 meshes to the square inch, adding water to said mixture and grinding the same until said particles are intimately mixed, applying said mixture in an even layer whose dried weight is from about 4 grams to about 12 grams per square foot to the metallic surface to be coated, and firing the same in a closed system containing a reducing gas, whereby a thin, even film firmly adhering to said metallic surface is formed.

2. The method of producing a thin adherent coating on the surface of a metallic base which comprises providing a mixture of a flux, a major proportion of at least one oxide of a metal of the group consisting of nickel, cobalt and chromium, and a minor proportion of at least one oxide of a metal of the group consisting of zinc, tin, and lead, the particles of said mixture being of such fineness that substantially all will pass through a sieve having 200 meshes to the square inch, adding water to said mixture and grinding the same until said particles are intimately mixed, applying said mixture in an even layer whose dried weight is from about 4 grams to about 12 grams per square foot to the metallic surface to be coated, and firing the same in a closed system containing a reducing gas, for a period of from about 15 to about 45 minutes, whereby a thin, even film firmly adhering to said metallic surface is formed.

3. The method of producing a thin adherent metallic coating on the surface of a metallic base which comprises providing a mixture of a flux, a major proportion of at least one oxide of a metal of the group consisting of nickel, cobalt and chromium, and a minor proportion of at least one oxide of a metal of the group consisting of zinc, tin, and lead, the particles of said mixture being of such fineness that substantially all will pass through a sieve having 200 meshes to the square inch, adding water to said mixture and grinding the same until said particles are intimately mixed, applying said mixture in an even layer whose dried weight is from about 4 grams to about 12 grams per square foot to the metallic surface to be coated, and firing the same in a closed system containing a reducing gas, at a temperature of about 1550° F. for a period of from about 15 to about 45 minutes, whereby a thin, even film firmly adhering to said metallic surface is formed.

4. The method of producing a thin adherent metallic coating on the surface of a metallic base which comprises providing a mixture of a flux, a major proportion of at least one oxide of a metal of the group consisting of nickel, cobalt and chromium, and a minor proportion of at least one oxide of a metal of the group consisting of zinc, tin, and lead, the particles of said mixture being of such fineness that substantially all will pass through a sieve having 200 meshes to the square inch, adding water to said mixture and intimately mixing the particles in said mixture, applying said mixture in a thin even layer to the metallic surface to be coated, and firing the same in a closed system containing a reducing gas, whereby a thin, even film firmly adhering to said metallic surface is formed.

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