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COATING METALS

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This invention relates to a method of coating metals, and more particularly to the hot-coating of one metal by another.

In the coating of a surface with molten metal it frequently becomes necessary to apply a protective coating upon the surface to protect it, for example from oxidation. For example, in the manufacture of bearings in which a steel or ferrous metal surface is coated with a molten layer of some other metal, such as copper, it is essential that the steel be protected by a flux, particularly while it is being heated just before the coating operation. The use of such a flux is attended by considerable difficulty in that it either tends to break off, or fails to wash off in advance of the metal coating.

It has now been discovered that these difficulties may be overcome if the surface to be coated is protected with a primary, high melt point flux which is still non-fluid, or at least viscous near the melting point of the coating metal, and the surface is then progressively coated with molten metal upon which is floated a second flux which will greatly lower the surface tension of the viscous flux so that it is completely and readily removed.

For example, in the manufacture of a bearing from a steel cylinder which is to be coated on the inside with a copper alloy, the interior of the cylinder is uniformly coated with a flux which will remain viscous at about the melting point of the copper alloy. This coating is preferably accomplished by suspending the flux in a volatile liquid, rapidly revolving the cylinder, and applying the suspended flux therein so that it is uniformly coated by centrifugal force upon the inside of the cylinder and then drying the volatile liquid while so revolving the cylinder. Sometimes it is advisable to admit a current of hot air inside the rotating cylinder during this process.

One end of the cylinder may then be closed, a core, such as a carbon core, inserted within it to leave the proper space for the copper coating, and molten copper alloy admitted from the bottom, the cylinder being maintained in a vertical position.

Before the metal is admitted, however, the cylinder and core are heated approximately to the melting point of the alloy, and a fluxing material capable of markedly lowering the surface tension of the viscous flux is placed in the bottom of the cylinder in such manner that it floats upon the surface of the molten metal. The molten metal is then added, for example, through an opening in the core leading to the bottom of the cylinder

or through other opening in the bottom, and thus progressively contacts the surface of the cylinder. As the molten metal rises, it carries on its surface the secondary flux, which completely removes the primary flux as it touches it. In this manner it is possible to obtain an adherent coating even in the case of ordinarily very difficultly wet metal, such as steel and copper-lead alloys.

A preferred primary or viscous flux may be prepared by the use of sodium borate ($\text{Na}_2\text{B}_4\text{O}_7$) and calcium fluoride (CaF_2). These materials should be extremely dry and anhydrous. In preparing the flux from them it is preferred to grind the ingredients, for example, in a porcelain ball mill while wet with anhydrous methanol, for a long period, for example, about 48 hours. It is preferred that the grinding be continued until the materials are almost colloidal, and will remain in suspension for say one or two hours. After the creamy suspension is formed, it is preferred to keep it in tightly corked bottles if it is not to be used within a short time.

The flux may then be applied either by dipping or as previously described by centrifugal action, and is dried in place.

A mixture of 25 parts of calcium fluoride and 75 parts of the borax glass is preferred, although a mixture of 20 parts of the fluoride and 80 parts of the borax is substantially as good and a range of 15 to 30 parts of the fluoride and 70 to 85 parts of the borax glass is suitable for normal operations.

The percentages of course depend to a considerable extent upon the melting point of the metal which is to be coated.

In case of the foregoing primary flux, a satisfactory secondary flux is anhydrous calcium fluoride in powdered form. It is not necessary to use an extremely fine powder for the secondary flux.

The primary flux is ordinarily applied to a depth of about $\frac{1}{8}$ th inch, and the ratio of primary to secondary flux is ordinarily about 10 grams of primary flux to 8 to 10 grams of secondary. The ratio will depend to a great extent upon the temperature of the molten metal.

The foregoing detailed description is given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, but the appended claims should be construed as broadly as permissible in view of the prior art.

What I regard as new, and desire to secure by Letters Patent, is:

1. The method as set forth in claim 4, in which the primary flux comprises a major portion of

anhydrous finely divided borax glass and a minor proportion of finely divided anhydrous calcium fluoride, and the secondary flux is anhydrous calcium fluoride.

5 2. A flux comprising 70-85 parts of anhydrous finely divided sodium borate and 30-15 parts of anhydrous finely divided calcium fluoride.

3. A flux as set forth in claim 2 in which the sodium borate is 75 parts and the calcium fluoride
10 25 parts.

4. In a process of hot-coating molten metal upon a preheated metallic surface, in which the metallic surface is coated with a primary flux which, at the preheating temperature, is plastic
15 enough to protect the surface and is viscous enough to maintain a protecting layer on a vertical wall of the surface, in which the flux-coated surface is preheated to about the melting point of the coating metal, and the flux coated surface
20 is progressively immersed in the coating metal; the steps of floating upon the surface of the coating metal a second flux having the property

of forming a free flowing flux with the primary flux, and progressively immersing the flux-coated surface therein, whereby prior to or immediately upon entrance of the surface into the coating metal it is entirely free of flux. 5

5. The method as set forth in claim 4 in which the surface is immersed in a rising, continuously augmented body of molten coating metal having a molten secondary flux on its upper surface, wherein flux removed from the flux-coated metal-
10 lic surface is floated upwardly.

6. The method as set forth in claim 4 in which the primary flux comprises a major portion of anhydrous finely divided borax glass and a minor proportion of finely divided anhydrous calcium
15 fluoride, and the secondary flux is anhydrous calcium fluoride.

7. The method as set forth in claim 4 in which the coated surface is a ferrous metal surface, and the molten metal has a melting point of the order
20 of that of copper.

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