

UNITED STATES PATENT OFFICE

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PROCESS FOR COATING METAL ARTICLES WITH LEAD

No Drawing.

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It has long been the practice to protect articles of iron intended for use in conditions in which they are exposed to corrosion with a less readily oxidizable metal, such as zinc. The superiority of lead as a coating for this purpose and particularly where the articles in question are to be exposed to acid corrosion, has long been recognized, but its use has heretofore been limited because of the difficulty or impossibility of consistently securing coatings which are firmly united to the body metal throughout and free from openings through which the metal beneath can be attacked. The lead coating as heretofore applied is liable to peel over more or less extensive areas in which it is not firmly attached to the metal beneath, and it is furthermore apt to contain pin holes which afford access by acids or other corroding agents to the metal beneath. Our invention of the present application provides a process for coating metal, and particularly iron articles, with lead, which produces a dense, continuous and firmly adherent metal coating, which is free from pin holes and other imperfections and will not peel. While applicable to the coating of other metals, it is particularly useful in connection with the protection of iron and steel of all kinds and we have found it of especial value for the coating of iron and steel pipe, such as is used for plumbing and in other situations in which the pipe is especially exposed to corrosive fluids. In the following specification we have described the process more particularly with respect to its application to steel pipe, but it is to be understood that it is not limited to use in connection with pipe or to articles of iron or steel.

In practicing our process, the articles to be coated are first thoroughly cleaned of scale, which may be done by the usual mechanical and pickling operations. The next step in the treatment is to deposit chemically or electro-chemically on the pipe or other article to be covered, a thin film of lead. Obviously it is not essential that pure lead be used in this or in the succeeding step of the process to be described later on, but alloys thereof including commercial lead may be used. Pure lead, however, is entirely satisfactory for the purpose. By reason of the fact that the first coating is deposited from a solution, whether chemical or electro-chemical, the metal thereof thoroughly penetrates the surface pores and cavities of the body metal and interlocks the covering film therewith so that a coating is formed which is firmly adherent at all points of the surface of the article and is practically continuous and free from pin holes and imperfections. There is thus formed on the article a cementing layer of metal which mechanically interlocked therewith (if not also partially alloyed with the body metal, as to which there may be some question) and being of practically the same composition as the final coating also, under the conditions of treatment by which the latter is applied unites firmly and throughout therewith. The second and final coating which is of substantially greater thickness than the preliminary, is preferably produced by dipping the article in molten lead which probably causes an incipient or surface fusion at least of the preliminary metal film, so that the two coatings become in effect, one, which is entirely or substantially homogeneous, and firmly adherent to the surface of the article in question. It is not essential, though for practical purposes it has been found advantageous, that the metal of the preliminary film and that of the final coating be identical, but they should be capable of alloying or fusing into each other. It has been found of practical advantage to use lead for both coatings, ordinary commercial lead being satisfactory for the second or major coat. However, in practice it has also been found that tin may be used for the final coating, and in some cases a coating of this metal is advantageous.

The first step in our improved process is the usual preliminary one of cleansing the pipe or other article to be coated. It may be first mechanically treated to remove scale, sand or other foreign matter, and then chemically cleaned, preferably by means of alkali and a pickling solution. Preferably any surface irregularities are removed in the mechanical treatment and the pickling operation

etches and somewhat roughens the surface, microscopically pitting it, and thus preparing it so that the preliminary coating or film will more readily penetrate and interlock with the body metal. After pickling the articles to be coated are thoroughly washed.

The preliminary coating or film of lead is next deposited on the pipe or other article being treated before opportunity is given for oxidation or corrosion thereof. Any method of forming this preliminary coating by deposition may be employed which will yield a continuous film firmly united to the body metal. We have successfully used chemical deposition for the purpose, employing a very dense solution of lead acetate heated to a temperature in excess of 150 degrees F. But better results have been obtained by us by means of electrodeposition. A suitable bath for this purpose may be made by dissolving about 60 lbs. of soda ash in 100 gallons of water and adding 10 lbs. of lead acetate thereto. A small current density, for example about one-half ampere per square foot of surface coated is best employed. With such a bath and current density thirty to eighty minutes' immersion is ordinarily sufficient to secure the required coating. Other methods of chemical and electro-chemical deposition may of course be employed. Ordinarily a single treatment of this kind is sufficient to provide a firmly adherent film free from pin holes and other imperfections. It is advisable, however, before applying the final coating, to test the preliminary film for pin holes. This may conveniently be done, in the case of iron or steel articles, by dipping them in a solution of potassium ferro-cyanide. Any pin holes will discover themselves by the blue color produced by the testing solution and if such are found the article should be returned to the bath. A short second treatment is usually sufficient to close any pin holes, but if test shows that this has not been done, the plating should be repeated until a perfect coating results. The pipe or other article in question is now found to be covered with a thin, uniform, continuous coating of lead, which, if not actually alloyed with the body metal, at least is firmly attached thereto by interlocking of the two metals and will not peel off or permit the penetration of liquid to the metal beneath.

The articles being coated are next fluxed and heated before immersion in the lead bath by which the final coating is applied. In the preferable form of the process the next step after the preliminary film has been applied, is the application of cold flux thereto. For this purpose any of the common fluxing solutions may be used, as, by way of example, a solution of zinc chloride and hydrochloric acid. The flux may be allowed to dry upon the article before further treatment. The articles are then heated in a fluxing bath. We

have found that by employing first a fluxing solution and thereafter a molten flux, that a more even and adhesive coating of metal may be obtained in the molten bath. It is our belief that this is due to the fact that the cold solution more thoroughly reaches all parts of the metal surface and that the molten flux liquefies and renders effective such portions of the flux applied in solution form as may remain in the cavities or pores of the metal. We have found it advantageous to use as this hot flux a composition containing about 80 per cent of zinc chlorid and about 20 per cent of common salt. In this bath the pipe or other article being treated is heated to a high temperature. Preferably they should be heated therein to a temperature approaching that of the lead bath in which they receive their major coating. Even better results are secured by heating the articles before immersion in the molten coating bath above the temperature of the latter. We have found it desirable on the whole to maintain the lead coating bath at a temperature of approximately 700 degrees F., the particular temperature employed depending largely on the thickness of coating metal desired, the higher the temperature of the bath, the thinner the coating. The hot flux may well be maintained at a temperature about 100° F. higher than that of the lead coating bath and preferably the articles under treatment remain in the hot flux until they are substantially at the temperature thereof. I have found it advantageous to remove the pipe from the flux for a very short interval of time and then return it thereto. This may well be done after the pipe has reached approximately the temperature of the flux. Preferably, where pipe is the article being treated it is revolved or turned about its axis in the flux during the treatment as this has the effect of more thoroughly applying and distributing the flux over the surfaces of the pipe. In order to conveniently and satisfactorily maintain the flux at the desired temperature the bottom of the vat or tank containing it is preferably charged with lead or other metal which is liquid at the temperature at which it is desired to maintain the flux. The flux floats on and is in large part indirectly heated through the lead bath, which occupies the hottest part of the furnace.

From the hot flux the pipe or other articles being coated are conveyed directly to the lead coating bath which, as before stated, is maintained at a temperature of about 700° F. By heating the article in the flux to a temperature more or less above that of the lead bath the most favorable condition for a close union between the lead of the bath and the film of lead on the pipe is afforded. The film being so thin and penetrating as it does the pores and pits of the body metal of the article the application of a temperature well

above the melting point of the metal of the film does not in any way affect the distribution thereof and by reason of the film of flux thereon prior to its immersion in the lead bath it is thoroughly protected from oxidation and cleansed of any oxide or other substance which might otherwise interfere with the adhesion of the coating from the molten bath of lead. It is important that the article to be treated shall be rotated or otherwise given movement in the lead bath, as well as in the molten flux, so that the liquid metal may be brought into intimate contact therewith. The relative movement of the pipe with respect to the lead both assists in removing the fluxing material and any foreign matter which might interfere with the union of the metal of the bath with the preliminary coating.

As the pipe is taken from the lead bath it is preferably maintained in rotation until the fluid lead thereon has set. Preferably the pipe is next submerged and rotated in quenching oil. For this purpose the quenching oils commonly found on the market having a flash point of about 585° F. have been found satisfactory. In order to rotate the pipe in the quenching oil the container or vat for the latter may well be of considerable width and provided with an inclined bottom or inclined guides down which the pipe may be rolled. The quenching bath may well be maintained at a temperature of about 300°. The introduction of the hot pipe or other articles from the lead bath of course tends to raise the temperature of the quenching bath. The latter may well be controlled by maintaining a body of water in the bottom of the oil bath and the temperature of the water and therefore of the oil may be controlled by the introduction of hot or cold water and the removal of surplus water from time to time as required.

We claim:

1. In a process for coating metal articles with metal, depositing a preliminary coating thereon from a solution of lead, applying an aqueous solution of a flux thereto, then applying a molten flux thereto, then dipping in molten metal. 110
2. In a process for coating metal articles with metal, depositing a preliminary coating thereon from a solution of lead, applying an aqueous solution of a flux thereto, then applying a molten flux thereto, then dipping in molten metal, and cooling in oil. 115
3. In a process for coating metal articles with metal, depositing a preliminary coating thereon from a solution of lead, applying an aqueous solution of a flux thereto, then applying a molten flux thereto, then dipping in molten metal, and cooling in oil, maintaining the oil at the desired temperature by floating it on water. 120
4. In a process for coating metal articles with metal, depositing a preliminary coating 125

thereon from a solution of lead, applying an aqueous solution of a flux thereto, then applying a molten flux thereto, then dipping in molten metal, cooling in oil, maintaining the oil at the desired temperature by floating it on water, and varying the temperature of the water as required. 70

5. In a process for coating metal articles with metal, electroplating the articles with a preliminary film of metal, dipping the articles in a cold aqueous flux and permitting the flux to dry thereon, then heating the articles in molten flux, and dipping them in molten metal. 75

6. In a process for coating metal articles with metal, electroplating the articles with a preliminary film of metal, dipping the articles in a cold aqueous flux and permitting the flux to dry thereon, then heating the articles in molten flux, dipping them in molten metal, and quenching them in oil. 80

7. In a process for coating metal articles with metal, depositing a preliminary coating thereon from a solution of lead, applying an aqueous solution of a flux thereto, then applying a molten flux thereto, then dipping the articles in molten metal, then cooling them in oil, maintaining the oil in which the articles are cooled at the desired temperature by floating it on water, and replacing the water with fresh water from time to time to maintain the proper temperature. 85

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