Patented Aug. 25, 1936 2,052,363

UNITED STATES PATENT OFFICE

2,052,363

PROTECTING METAL SURFACES FROM CORROSION

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No Drawing. Application November 10, 1931, Serial No. 574,225

5 Claims. (Cl. 91—70.2)

This invention relates to an improved process of protecting metal surfaces from corrosion and to the product resulting from the practice of such process.

The process of galvanizing has long been recognized as the most satisfactory commercial process for protecting from corrosion the surface of ferrous metal bodies used for structural purposes, such as iron beams, nuts and bolts, iron pipe and the like. Other processes of protecting ferrous and other metals from corrosion have been suggested and used where the resulting material has been employed for other purposes. For example, it has been customary for sheet iron to be plated with tin when the resulting product is to be used in the manufacture of containers and the like. More expensive processes of protecting metal surfaces against corrosion have been widely used when beauty of appearance has been a primary factor and the expense involved has not been of controlling importance. All of these processes as commercially practiced have met with success in varying degrees. However, the majority of the processes have been attended with one or more marked disadvantage. In some instances the cost of operation has been such as to render the processes commercially uneconomical. In others, the protection of the metal has been but temporary. In the case of galvanizing processes, the principal disadvantage has been that the galvanized article would not permit substantial bending, distortion, or abrasion due to the low degree of elasticity of the coating and the relative softness of the coating film.

In an effort to overcome the principal disadvantageous features of several of the processes now in use for protecting metals from corrosion, and particularly in an effort to overcome the important disadvantages attendant upon commercial processes of galvanizing ferrous metal bodies, we have discovered what tests have demonstrated to be a very superior process of protecting metal surfaces from corrosion. The process is not only commercially economical and practicable but produces products which are strongly resistant to the action of corrosive agents normally encountered in actual practice and which are capable of being bent and distorted without having the protective coating removed therefrom.

In the practice of our process the metal object to be protected, such as ferrous metal sheets, nuts and bolts and the like, is provided with a continuous coating of an alloy comprising a major proportion of a metal which is resistant to acids and a minor proportion of a metal which is higher in the E. M. F. series than iron. When we speak of an acid resistant metal we mean a metal which is not readily attacked by solutions of acids. Of course the metals may be subject to attack by certain concentrated acids but we intend that the term "acid resistant metal" shall be applied as the term is commonly understood in the art. Lead is a notable example of the type of metal referred to and other similar metals are specifically mentioned below.

Although it is not necessary in many instances, we prefer to pretreat the metal to be protected in such a manner as to provide on the surface thereof a thin film of lead. This may be accomplished by known methods but we prefer to employ the method disclosed in our copending application Serial Number 574,224, filed November 10, 1931. Briefly, this method consists in subjecting the metal to be treated to the action of a conventional pickling solution to give the metal a bright pickle. Thereafter, the metal is washed and then immersed in a molten bath of a lead soap of a non-soap forming fatty acid, preferably lead acetate, for a short period of time after which the treated metal is removed from the bath and the viscous mass present thereon mechanically removed and the resulting product washed with water or a solution of acetic acid followed by a cold water wash. This treatment results in the deposition on the base metal of a film of lead which is ordinarily about 0.0001 of an inch in thickness. The metal object to be protected when treated in this manner is ready for treatment in accordance with the present process as hereinafter described. In the event that it is not desired to first coat the metal to be protected with a film of lead, the surface of the metal should be given a bright pickle in any conventional manner and promptly thereafter treated in accordance with the present process.

In practicing the process an alloy of the character referred to above is melted in a pot preferably by electric resistance heating. The exact temperature to which the alloy is heated is not of controlling importance providing that the temperature is sufficient to maintain the mass in molten condition during the treatment. However, we have found that it is advantageous to maintain the temperature about 20° C. above the melting point of the alloy. If a substantially higher temperature is used excessive splashing of the alloy results and the temperature may be sufficient to cause the decomposition of the flux which is preferably used. Moreover, if the tem-

perature is too high the film of alloy deposited on the metal may be too thin.

As indicated above, we prefer to add to the alloy in the heated pot a flux to keep the surface of the molten alloy covered during the operation of the process. In some instances a simple flux such as zinc chloride may be used but we prefer to employ a flux consisting of 80 per cent. zinc chloride, 15 per cent. sodium chloride and 5 per cent. potassium chloride, the percentages being calculated in parts by weight. Moreover, we have found it advantageous to add granular carbon, such as ground charcoal, to the flux to restrict or prevent oxidation of the metals present.

In coating the metal objects to be protected it is necessary to leave the metal objects in the bath only for sufficient time to bring their temperature up to the temperature of the bath. This is generally accomplished in two or three minutes. In the case of small metal objects, such as iron nuts and bolts, these are preferably introduced into the bath in a wire basket which is moved up and down during the period that the objects are immersed in the bath. In the case of metal sheets these are introduced directly into the bath by means of tongs and the sheets are preferably moved or rotated while in the bath. After the objects have been immersed for the desired period of time they are taken out and the excess metal removed in any conventional manner. In the case of small objects these are preferably handled in a centrifuge in accordance with conventional practice. After the removal of the excess of the metal and while the objects are still hot they are introduced into an oxidation preventing bath such as a 20 per cent solution of zinc chloride. This prevents oxidation of the coating and leaves a smooth surface.

Many alloys consisting of a major proportion by weight of an acid resistant metal and a minor proportion of a metal higher in the E. M. F. series than iron may be used in the practice of the process. However, for ordinary practice such as coating nuts and bolts, structural steel and the like, we prefer to use an alloy consisting of a major proportion of lead and a minor proportion of cadmium. While the cadmium content may be increased to as high as 50 per cent., we have found that a 4 per cent. cadmium content provides an alloy which is practically as good as can be obtained with any minor proportion of cadmium. A cadmium content of as low as 1 per cent. by weight may be used but we recommend a somewhat higher cadmium content and prefer that such content shall be approximately 4 per cent. When such an alloy is used it is mixed, preferably in the cold, with about 50 per cent. by weight of a flux of the character referred to above. Obviously, the amount of flux may be varied through a very wide range.

While a lead-cadmium alloy of the character referred to above provides a reasonably bright coating, in some instances it may be desired to have the finished coating even brighter, in which case a small amount of tin, say about 10 per cent. by weight, is mixed with the lead and cadmium.

A further modification of the lead-cadmium alloy consists in the addition of a small amount, say from .5 to 5 per cent. by weight of aluminum. Such an alloy is a particularly advantageous coating when the metal object is to be used around salt water. The presence of aluminum results in the formation of a thin oxide film on the surface of the coating which is strongly resistant to many corrosive agents.

Where low temperature work is involved, we prefer to employ a tin-lead-cadmium alloy. Almost any random mixture of these metals has a melting point below 200° C. but in preferred practice we employ an eutectic mixture of tin-lead-cadmium. This mixture, which consists of approximately 50 per cent. tin, 32 per cent. lead and 18 per cent. cadmium, has a melting point of 143° C. which makes this alloy particularly suitable for low temperature work.

A brilliant, corrosion resisting coating may be provided by the use of a mercury-cadmium alloy, the cadmium constituting from 20 to 40 per cent. by weight of the mixture. This alloy may also be modified by the addition of a small proportion of tin thereto. By the use of mercury, tin and cadmium, it is possible to secure an alloy having an exceptionally low melting point as well as a brilliant appearance.

While we have described in detail the preferred practice of our process it is to be understood that the details of procedure may be variously modified without departing from the spirit of the invention or the scope of the subjoined claims.

We claim:

1. The process of protecting metal surfaces from corrosion which comprises depositing a thin film of lead on the metal surface, and applying to the thus treated metal a coating of an alloy containing a major proportion of an acid resistant metal and a minor proportion of a metal which is higher in the E. M. F. series than iron, said alloy being selected from the group consisting of lead-cadmium, lead-cadmium-aluminum, lead-cadmium-tin, mercury-cadmium, and mercury-tin-cadmium alloys.

2. The process of protecting metal surfaces from corrosion which comprises depositing a thin film of lead on the metal surface, and applying to the thus treated metal a coating of an alloy the constituents of which consist of lead in major proportion and cadmium in minor proportion.

3. The process of protecting metal surfaces from corrosion which comprises depositing a thin film of lead on the metal surface, and applying to the thus treated metal a coating consisting of a lead-cadmium-aluminum alloy, the lead constituting the major proportion of the alloy.

4. The process of protecting metal surfaces from corrosion which comprises depositing a thin film of lead on the metal surface, and applying to the thus treated metal a coating consisting of a lead-cadmium-tin alloy, the lead constituting the major proportion of the alloy.

5. The process of protecting metal surfaces from corrosion, which comprises depositing a thin film of lead on the metal surface, and applying to the thus treated metal a coating of an alloy consisting of an eutectic mixture of tin, lead and cadmium.

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