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METHOD OF COATING METALLIC OBJECTS

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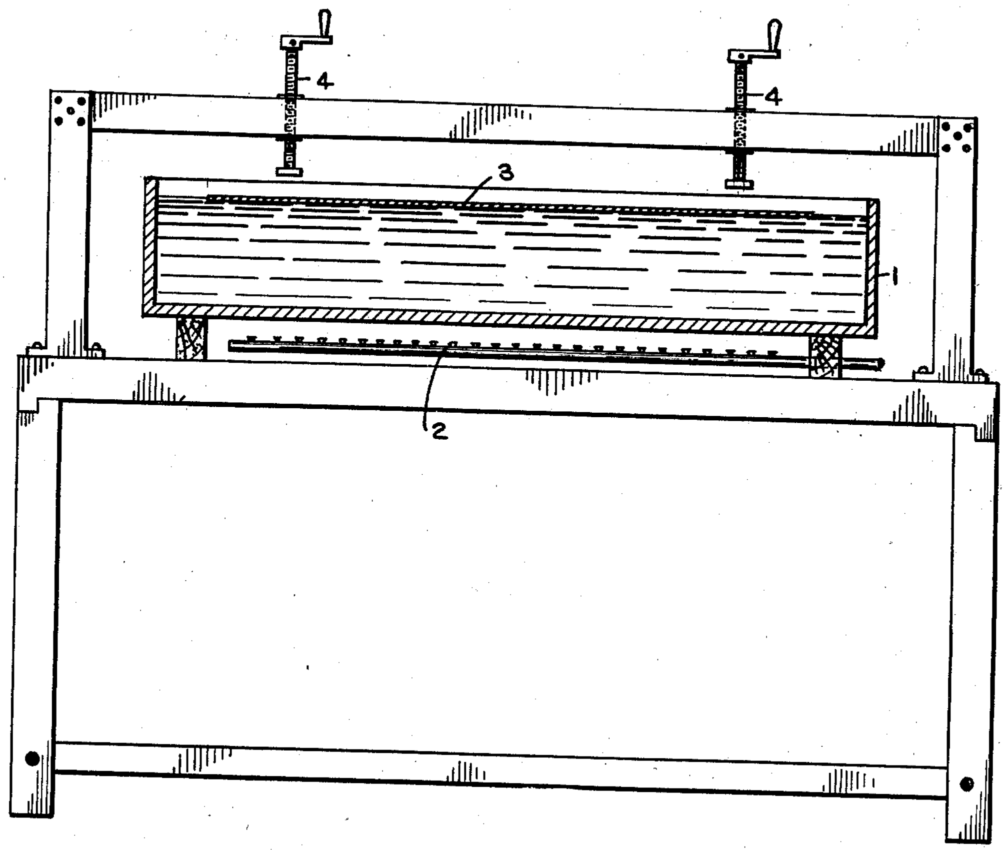

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METHOD OF COATING METALLIC OBJECTS

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The present improvements relate in general to methods for coating metallic objects and more particularly to methods for coating flat objects such as steel plates with metallic coatings of lead or lead alloys. It is understood, however, that the methods are of general application.

Much difficulty has been experienced in applying a coating of lead to steel sheets due to the inability, by previous methods, of applying a coating of uniform thickness as well as one with an even, smooth surface. As the coating is applied under high temperatures, uniform heating of the steel sheets has presented a great problem due to buckling thereof at high temperatures, rendering application of a coating extremely difficult.

A primary object, among others, of the present improvements, is to provide methods and means for overcoming the above mentioned difficulties and facilitate the coating of steel objects with lead.

A further object, is to provide improved methods for heating the objects to be coated as well as novel methods of applying the coating to the objects. Another object is to provide a method of the character described wherein the object is uniformly heated, thereby eliminating warping or buckling and wherein a smooth, even coating of uniform thickness is applied with a minimum of time, effort and expense.

Other objects of the improvements will be apparent as the description progresses. Apparatus for practicing the method is illustrated in the accompanying drawing, being merely a typical example which may be varied at will to suit the specific application as will be readily understood by those skilled in the art.

The apparatus consists of a welded steel, cast iron or heat resisting alloy tray 1, suitably braced with ribs or other supporting members to prevent excessive warping during heating. This tray may be of any dimensions but should be conveniently larger than the maximum size of the sheets to be coated. This tray is supported in a convenient manner and is heated from underneath by any of the usual sources of heat such as a gas burner 2, electricity, oil, coal or coke, etc. For many processes it has been found advisable to use the source of heat which may be controlled within exact limits, that is, the use of automatic temperature control on the molten bath is of paramount importance, so that the choice of a heating medium should be directed to this end.

Let it be assumed, as a typical illustration, that a flat sheet of steel is to be coated with a bonded coating of pure lead one quarter of an inch in thickness on one surface only. This sheet is thoroughly cleansed by pickling in a suitable acid solution or by other means so that a chemically clean surface is offered.

The tray 1 is filled with pure lead to any desired depth, preferably three or four inches and is heated until the required temperature is attained. During the heating the lead is reduced to a highly heated molten state and due to its high heat conductivity presents a uniform temperature throughout its liquid or molten area. The thoroughly cleaned sheet 3, to be coated, is then disposed in the molten lead bath. Since the steel is of less density than the lead bath, the steel floats on the surface thereof, leaving the upward face exposed. This face or upper surface is now treated with a suitable flux, such as tin, solder or other bonding materials as are familiar to those skilled in the art.

It may be noted here that the floating steel sheet is thoroughly and uniformly heated by the heat of the molten lead. Since the latter has a uniform temperature, all portions of the steel sheet are heated uniformly so that no warping or deforming of the sheet occurs. Accordingly, the sheet is perfectly flat and even, in its heated condition at the time of applying the coating.

The sheet 3 is now forced under the surface of the molten lead to a depth of one quarter inch by any convenient means such as weights or leveling screws 4. The sheet is thus completely covered and surrounded by the molten lead. The surface of the lead is then skimmed and cleaned free of oxide, dross and impurities. While the sheet is thus held submerged in the molten lead, the source of heat is removed or extinguished and the molten lead allowed to solidify by natural cooling or by suitable artificial means such as water sprays or air blasts.

After the mass has solidified and cooled, a groove is cut in the surface of the lead around the edge of the sheet. Since only the upper surface of the sheet had been treated to cause a coating of lead to adhere thereto, the coated sheet is readily removed. As is manifest, the lead does not adhere to the under surface and therefore does not resist removal of the sheet. Other methods for removing the coated sheet may be employed for example, unpickled angles or T bars may be inserted around the edges of the sheet before solidification of the lead, which eliminates the necessity of cutting a groove around the sheet to free it after solidification, since these bars act as separators. It is obvious that such bars may be employed to immerse the sheet in the molten lead. In this event the portions of the bars overhanging the edges of the sheet, will leave a border free from the lead coating, thereby facilitating the joining of such sheets along the edges.

The foregoing method represents a marked departure over previous methods. The lead coating on the sheet is uniform in thickness, thereby eliminating any subsequent treatment thereof, such as chipping to reduce uneven portions. Likewise, the lead surface is smooth, even and has a high lustre, rendering it admirable for use in chemical equipment and insuring against attack by the chemicals, since it is free of imperfections and impurities. The opportunity in this method, of removing oxides and impurities caused by the association of the two metals but before they are bonded, cannot be overemphasized.

In employing the present method, the sheets to be coated are not warped or deformed at any time. Accordingly, materials which heretofore could not be coated, such as light gauge sheet steel, can now be coated. In fact sheet steel of any desired gauge can be coated to any desired thickness, the practical use of the bonded product being the only factor influencing the thickness of either metal. It is manifest that production costs are greatly reduced and the time required for coating a sheet is decreased. At the same time, a more perfect product results since the thickness of the coating can be controlled and is accurate. Likewise the coatings applied are free from dross, oxide segregations and inclusions so that the possibility of "pin holes" or imperfections of the surface is eliminated.

As a further economy in production, several sheets may be coated at one time by stacking them upon one another. After the first sheet has been immersed in the molten bath, as above described, all flux, impurities, etc. are carefully removed from the surface of the molten lead and the second sheet floated thereon. To keep the sheets separated, spacers of unpickled iron or other material of a thickness equal to the thickness desired on the immersed sheet are first placed on the upper surface of the immersed sheet. The second sheet is then suitably treated with a flux on the upper surface and is forced beneath the surface of the molten lead, so that both sheets are now submerged in the molten bath, being separated by the spacers and the molten lead therebetween which finally forms the coating of the lower sheet. This procedure may be repeated until the tray is filled and, after solidifying, the entire stack of coated sheets may be removed, as before described. Since only the upper surfaces of the sheets have been treated with bonding material, their under surfaces do not adhere to the coating of the sheet beneath, and the coated sheets may be separated or peeled with ease.

The foregoing procedure may, of course, be reversed, by treating the under surfaces of the sheets for bonding with the lead and immersing them in spaced relation in the molten bath and forcing the stack downward until the lower sheet is spaced from the bottom of the tray as is required to give the thickness of the coating desired. In coating a plurality of sheets at one time, it is manifest that they may be immersed successively or simultaneously as may be found practical and convenient.

Where none of these modifications are applicable this tray or pan may be used to float another smaller tray containing the alloy metal or material and the warping of thin flat objects avoided since the lead bath will give very uniform heating over a large surface and has a high rate of heat transfer.

Although the method has been described by way of example, as applied in the coating of steel sheets with lead and lead alloys, the principles outlined may be utilized in coating copper, brass, aluminum or other materials with various coatings desired.

For materials which are more dense than the coating which is to be applied and which will not float, sufficient of the molten metal or other material may be poured into the tray containing the material to be coated to cover the sheet or article to a sufficient thickness. It is likewise evident that sheets or other objects of steel or of metals may be coated with lead in this manner, as hereinafter described.

In the case of the application of alloys, metals or other materials such as tin, which directly unite to form a continuous coating on steel or the material to be coated and if such a continuous coating is not desired over the entire surface, such surfaces may be treated with whiting-sodium silicate paste or other materials known to those skilled in the art to prevent this adhesion and the procedure as outlined for lead coating followed.

In practicing the present improvements it is evident that the coating may be applied to the sheet floating on the molten lead without depressing the sheet beneath the surface. This may be accomplished by anchoring or otherwise holding the sheet in such floating condition, so that it will not rise with the level of the lead when more is added. Accordingly, instead of employing screws 4 in the drawing to depress sheet 3, the former may be advanced until they engage the sheet, so as to prevent rising thereof, and then more molten lead may be added to the bath in tray 1 until the depth thereof above the sheet is sufficient to form the desired thickness of the coating on the sheet. Cooling and removal of the coated sheet may then be effected as previously described.

It is to be noted that the present methods also contemplate the application of a coating of predetermined thickness to both sides of a sheet. This feature has many applications and can readily be accomplished by only slight variations of the procedure. For example, if a sheet one quarter inch thick is to be coated on both surfaces with a one quarter inch coating of lead or other material, an unpickled or unfluxed sheet is immersed in the molten bath in the tray with its upper surface three quarters of an inch below the surface of the bath. The sheet to be coated is then treated on both upper and lower surfaces with a suitable flux or bonding material and is then floated on the molten metal and immersed so that the upper surface of this sheet is one quarter inch below the surface of the bath. The under surface of the sheet will then be one quarter inch from the upper surface of the previously immersed unpickled sheet, thereby yielding a coating of lead or other material one quarter inch thick on both surfaces of the treated sheet. This procedure may be further varied by using the bottom of the tray in place of employing an unpickled sheet and maintaining sufficient molten lead or other material in the tray to give the required thickness of coating on both sides of the sheet when it is immersed. Obviously, these steps are followed by cooling and removal of the sheet as previously set forth.

It is notable that the methods herein set forth may be practiced in various ways and that the apparatus described may be modified, since that described is merely exemplary. Various means may be employed for depressing the sheets in the bath and predetermining the thickness of the coating. Furthermore, various types of bonding material may be employed and applied either before or after the sheet is floated on the bath. It is manifest therefore, that various modifications may be made by those skilled in the art without departing from the principles and purview of the invention.

I claim:

1. In a method of coating metallic objects the steps comprising heating the coating material to a liquid state, heating the object to be coated by the heat of the liquid coating material, holding the object immersed in the coating material, and cooling the coating material while the object is immersed therein.

2. The method of coating metallic objects comprising heating the coating material to a liquid state, preparing a portion of the object for the reception of a coating, heating the object by the heat of the liquid coating material, depressing the object in the coating material, and cooling the coating material while the object is contacting same.

3. In the method of coating steel sheets the steps comprising reducing lead to a hot molten state, floating a steel sheet thereon for uniformly heating same, and predetermining the thickness of the coating by predetermining the relation of the sheet to the mass of molten lead.

4. In the method of coating steel sheets the steps comprising reducing lead to a hot molten state, floating a steel sheet thereon for uniformly heating same, disposing a second sheet in spaced relation to said floating sheet, immersing the sheets to the desired depth in the molten lead.

5. The method of coating steel sheets comprising reducing lead to a hot molten state, floating a steel sheet thereon for uniformly heating same, applying a flux to the upper surface of the sheet, immersing the sheet to the desired depth in the molten lead whereby the lead flows over the upper surface of the sheet and cooling the molten lead with the sheet thus submerged.

6. The method of coating steel sheets comprising maintaining lead in a highly heated molten state, treating one face of a steel sheet with a flux, floating said sheet on the molten lead with the treated face upward, covering said treated face with molten lead to the desired thickness and cooling the lead and sheet.

7. The method of coating steel sheets comprising maintaining lead in a highly heated molten state, treating one face of a steel sheet with a flux, floating said sheet on the molten lead with the treated face upward, covering said treated face with molten lead by depressing the sheet beneath the level of the molten lead, solidifying the lead and removing the sheet from the solidified mass of lead.

8. The method of coating steel sheets comprising maintaining lead in a highly heated molten state, treating one face of a steel sheet with a flux, floating said sheet on the molten lead with the treated face upward, covering said treated face with molten lead by depressing the sheet beneath the level of the molten lead, solidifying the lead, cutting the lead along the border of the sheet and removing the sheet.

9. The method of coating steel sheets comprising heating a mass of lead to a highly heated molten state, treating one face of a steel sheet with a flux, heating said sheet by disposing it upon the molten lead with the treated face upward, covering the treated face with molten lead while the sheet is being thus heated, solidifying the lead with the sheet thus covered and removing the sheet from the mass.

10. The method of coating steel sheets comprising heating a mass of lead to a highly heated molten state, treating one face of a plurality of steel sheets with a flux, heating said sheets by disposing one sheet upon the molten lead with the treated face upward, disposing a second sheet with the treated face upward upon said first sheet in spaced relation, depressing said sheets beneath the level of the molten lead, solidifying the lead with the sheets thus covered, and removing the sheets from the mass.

11. The method of coating steel sheets which comprises treating a portion of the steel sheet with a bonding material, disposing said sheet on a mass of molten lead, covering said sheet with molten lead of the desired thickness, and cooling the lead with the sheet thus covered.

12. The method of coating steel sheets which comprises treating a portion of the steel sheet with a flux, floating said sheet on a mass of molten lead, covering said sheet with molten lead to the desired thickness and cooling the lead with the sheet thus covered.

13. The method of coating steel sheets which comprises treating a portion of the steel sheet with a flux, floating said sheet on a mass of molten lead, positively immersing the sheet in the molten lead, predetermining the thickness of the coating of lead to be bonded to the sheet, and cooling the sheet and lead.

14. In a method for coating a flat flexible metallic sheet susceptible of buckling from uneven distribution of temperature wherein the sheet either will not take a coating without the use of a flux, or has been treated to prevent adhesion of molten metal employed to raise its temperature, the step of uniformly heating such sheet without buckling comprising reducing a metal to a molten state, and disposing the sheet flatwise upon the surface of the molten metal for uniformly heating the sheet so as to prevent warping or buckling thereof.

15. In a method for coating a flat flexible metallic sheet susceptible of buckling from uneven distribution of temperature, the step of uniformly heating the sheet without buckling comprising reducing lead to a molten state, and floating the sheet flatwise upon the surface of the molten lead for uniformly heating the sheet so as to prevent warping or buckling thereof.

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