

UNITED STATES PATENT OFFICE

1,996,657

METHOD OF JOINING METALLIC SURFACES

Randolph W. Shannon, New York, N. Y.

No Drawing. Application September 27, 1932,
Serial No. 635,131

7 Claims. (Cl. 29—189)

This invention relates to improvements in joining metallic surfaces and has particular reference to joining a lead covering to an iron or steel surface and, likewise, reinforcing a lead surface by joining thereto a backing of iron or steel.

In the prior art, lead coatings, applied to iron or steel by hot dipping, electro-deposition, spraying or other methods contain pin-holes or discontinuities in the coating to a greater or lesser degree depending upon conditions. Even though these be small or even microscopic, they greatly impair the usefulness of the lead coatings, particularly since the electrochemical relation of lead and iron is such as to cause a rapid eating away or corrosion of the iron or steel base when an electrolyte, such as water, is present between the lead and the iron. In such cases, the iron or steel dissolves in preference to the lead, causing a hole or perforation which destroys the value of the article. The same applies to coatings of tin or tin lead alloys which are likewise subject to discontinuities when applied by ordinary means, and likewise cause electrolysis destructive to iron. These facts explain why tin plate or terne plate sheets such as used for roofing must be painted to preserve them, otherwise they would rust through in spots where the coating contains discontinuities which the paint is required to cover and protect. It is this necessity for painting which restricts the value and use of ordinary lead, terne and tin coated iron or steel for resistance to atmospheric and more severe corrosion. The terms "tin plate" and "terne plate" are used here to refer to sheets of iron or steel carrying ordinary commercial coatings of tin and lead-tin alloy, respectively. The durability of lead in the atmosphere and its resistance to many corrosive substances is well known. It must be recognized that lead itself has structural deficiencies, such as its relative weakness and great weight per unit area, which cause it to sag when unsupported over any considerable distance unless used in large cross section with resultant high cost. The combination of an iron or steel base to provide strength covered with a perfectly continuous and uniformly bonded lead surface has not heretofore been made successfully or commercially practicable in the prior art and would obviously be a most useful product.

The invention has for its object the joining of lead and iron or steel by a uniformly adherent metallic union which will not be affected by changes in atmospheric temperature, expansion or contraction of the metals.

Another object is to provide such an impervious

union which will not be affected by moisture and the like and which will not require any additional protective coating such as paint on the lead covering.

Another object is to provide a union of such metals which will be exceedingly durable and capable of withstanding bending, tension or compression, as ordinarily applied.

Another object of my invention is to join lead sheets and ordinary commercial tin plate and terne plate without damaging the metals.

Another object of the invention is to join lead sheets to thinly coated commercial tin plate or terne plate by a metallic bond, without the necessity of additional materials or agencies other than heating, fluxing and pressing media.

Another object is to provide a metallic bond for lead and iron or steel when a very small amount of tin is present on or in only one of the surfaces to be joined.

A further object is to provide a new product which comprises a rolled or otherwise wrought lead covering joined to an iron or steel surface and, likewise, a reinforcing backing of iron or steel joined to a similar lead surface. The metals may be of any thickness.

A further object is to provide a process for making the above products which is inexpensive, practical and readily adaptable to large scale commercial operation.

It must be emphasized that the product of my invention is not merely an iron or steel sheet carrying a lead type coating as heretofore understood, since such coatings are more or less porous, being subject to pin-holes or minute discontinuities in the coating. The product of my invention can be more adequately described as a sound, perfectly continuous sheet or form of lead or lead alloy, to which, for the purpose of strengthening, iron or steel has been uniformly and adherently joined by a metallic bond.

It is of course possible to solder a piece of lead to a piece of iron but the means for so doing are expensive and not practicable for commercial operations.

My invention includes broadly the following process:

I make use of the fact that tin alloys with iron while lead does not, and further that lead and tin form an alloy at temperatures well below the melting point of lead. I take, for example, a sheet of commercial tin plate or terne plate and place thereon a suitable lead sheet, then by subjecting the sheets to suitable pressure while at a temperature which, while below

the melting point of lead, is high enough to cause lead and tin to react together when in intimate contact, I cause the tin content of one surface to react and create a low melting point tin-lead alloy with the inside surface of the lead sheet, which forms a coherent metallic union between the two inside surfaces, without causing the outside surface of the lead covering sheet to melt appreciably.

When joining the lead to a piece of iron or steel, coated with a tin-lead or lead-tin alloy, the principle is similar, the temperature used, while being below the melting point of the lead, being such as to cause melting of sufficient of the lead tin coating to react with the lead to provide the desired coherent metallic union.

Numerous specific methods may be employed to obtain the desired results, for example, a tin or tin-lead coated iron or steel sheet over which a lead sheet has been laid, may be placed upon a flat plate of metal which has been heated to the proper temperature and the whole subjected to pressure, either by a heavy weight, a mechanical or hydraulic press, or by passing through rolls. It may be desirable to preheat the press or rolls to the desired temperature.

While not essential, I have found it desirable to employ a substance between the lead and the tin or tin-lead coating on the iron or steel, to prevent or minimize oxidation and otherwise to prepare the surfaces for joining properly. For this purpose I have employed palm oil successfully, although other substances may be found equally suitable.

My preferred method is as follows: On a steel or iron sheet or plate coated with tin or tin-lead alloy, preferably, for economy, employing the thinner and cheaper coatings, a lead sheet is placed, then the whole is immersed in palm oil which has been heated to a temperature below the melting point of lead but above approximately 180° C. which is the melting point of tin-lead eutectic alloy when using tin plate; or when usingterne plate, to the point at which a substantial amount of a lead-tin alloy melts; after the whole has assumed appreciably the temperature of the palm oil, it is passed through a set of rolls which have been heated to a temperature below the melting point of the lead but above the melting point of tin-lead eutectic alloy (approximately 180° C.). I have determined that satisfactory results in this method are obtained with the palm oil at approximately 220° C. when the iron sheet is coated with tin, and approximately 250° C. when coated with lead-tin alloy; the rolls being at approximately the same temperatures. Obviously, other temperatures may be employed within the limits of the melting point of the lead and of the tin-lead eutectic alloy, or somewhere between 327° C. and 180° C. depending upon the materials and methods used and the results desired. The amount of pressure may be only sufficient to bring the surfaces into intimate contact or may be sufficient to deform the metals, particularly the softer lead.

For joining lead sheets to continuous sheets or strips of tin plate orterne plate, a preferred method is to feed a strip of lead against the surface of the coated iron or steel sheet as it emerges from the coating pot, the two adjacent layers, i. e., the coated iron or steel and the lead, being immediately conducted through rolls, the latter being heated to the desired temperature either by running in hot palm oil or by continued con-

tact with the hot tin plate orterne plate, or by other means.

In another method I take, for example, a sheet of lead-tin alloy containing 10% or more of tin, and place this upon a sheet of iron or steel, the surface of which has been previously cleaned as by pickling and treated with a suitable flux, then by heating the whole to a temperature approaching but not above the melting point of lead and subjecting it to pressure, I cause the lead-tin alloy to adhere to the iron or steel by virtue of the bond formed between the iron or steel and that portion of the lead-tin alloy which has become molten at the temperature employed.

Obviously, while my description has dealt largely with applying the lead to only one side of the iron or steel, the same principles under suitable arrangements permit the application to both sides.

Many incidental operations are possible and contemplated under my invention employing the same principle. For example, the edges of the base sheet may be covered with the lead by permitting the lead covering sheet to extend beyond the base sheet and folding these extensions over the edges of the base sheet, creating the same metallic union by suitable means. Also, the edges may be covered when desired, particularly where there is a "raw" or "cut" edge causing the iron or steel at the edge to be exposed, by dipping the edge in molten tin or tin-lead alloy, and, although this hot-dipping of the edges will not produce a perfectly continuous coating over such a "raw" edge, it will afford sufficient protection to the edge of a relatively thin section which ordinarily cannot be much injured by pin-hole corrosion proceeding inward from the edge.

The thicknesses of both the lead covering and the iron or steel base may be varied without limit, as desired. I have successfully applied rolled lead from .002 inches thick and thicker.

An important feature of my process, as it relates to bonding a lead sheet to one side only of commercial tin plate andterne plate, is that the bonding operation may be performed at temperatures and in such a manner as not to impair the protective quality of the thin tin orterne coating on the side to which the lead sheet is not applied. This is because it is possible to employ temperatures so low as not to cause the tin orterne coatings to become entirely molten, especially where not in contact with the lead sheet, but at such temperatures and under the pressures used, the reaction between the tin content of the coatings mentioned and the lead sheet takes place and provides the desired metallic bond between the inside surfaces. In this way, when a lead sheet is bonded to only one side of tin plate orterne plate, the thin tin orterne metal coating on the other side is not wasted, but will serve as a measure of protection to the iron for certain purposes where the lead sheet is needed particularly on only one side.

This does not mean, of course, that my process is limited to be carried on below the temperatures at which tin or the particularterne metal (lead-tin alloy) employed as the coating of the tin plate orterne plate becomes entirely molten, since under some conditions higher temperatures may be desirable although always under the melting point of lead.

When preheating by oil or other means, where the section of the pieces involved is so small as not to retain heat sufficiently long after removal from the preheating medium, then additional

heat must be applied prior to or coincident with the application of pressure.

The word "lead" is used here to refer not only to commercially pure lead, but also to any convenient analysis of lead containing other elements, such as antimony, bismuth, tin, cadmium, etc., to facilitate manufacture, because incidentally present and not necessary to remove, and to provide certain desirable properties to the finished lead-base alloy or for other purposes. The term "iron" also is intended to refer to its various compounds or forms. The term "wrought lead" is used to refer to lead which has been given its final form by mechanical means (rolling, hammering, pressing, extruding, etc.) as distinguished from being cast into its final shape and not having received mechanical working subsequent to solidifying from the molten state, and as distinguished from being deposited in finely divided condition or from chemical solution.

The products of my invention are not intended for any specific uses but may be used in any manner and wherever such products are found desirable.

It is understood that minor variations may be made in my invention without departing from the concept thereof.

Having thus described my invention, what I claim is:

1. The method of joining lead in sheet form to iron in sheet form, a surface of said iron having a coating containing tin, which comprises, contacting the lead sheet with a coated surface of the iron sheet and forming an alloy of the tin and the lead of the adjacent lead surface by applying heat below the melting point of tin, and pressure.

2. The method of joining lead in sheet form to iron in sheet form, a surface of said iron having a coating containing tin, which comprises, contacting the lead sheet with a coated surface of the iron sheet and forming an alloy of the tin and the lead of the adjacent lead surface by applying heat ranging between the melting point of tin-lead eutectic alloy and slightly above the melting point of tin and applying pressure.

3. The method of joining lead in sheet form to iron in sheet form, a surface of said iron having a coating containing from .015 ounces to .15 ounces of tin per square foot, which comprises, contacting the lead sheet with a coated surface

of the iron sheet and forming an alloy of the tin and the lead of the adjacent lead surface by applying heat below the melting point of tin, and pressure.

4. The method of joining lead in sheet form to iron in sheet form, a surface of said iron having a coating containing from .015 ounces to .15 ounces of tin per square foot, which comprises, contacting the lead sheet with a coated surface of the iron sheet and forming an alloy of the tin and the lead of the adjacent lead surface by applying heat ranging between the melting point of tin-lead eutectic alloy and slightly above the melting point of tin, and applying pressure.

5. The method of joining lead in sheet form to iron in sheet form, a surface of said iron having a coating containing tin, which comprises, contacting the lead sheet with a coated surface of the iron sheet and forming an alloy of the tin and the lead of the adjacent lead surface by applying heat between the melting point of tin-lead eutectic alloy and above the melting point of tin, but insufficiently above the melting point of tin to disturb the outer surface of the lead sheet to thereby impair its protective quality, and applying pressure.

6. The method of joining lead in sheet form to iron in sheet form, a surface of said iron having a coating containing from .015 ounces to .15 ounces of tin per square foot, which comprises, contacting the lead sheet with a coated surface of the iron sheet and forming an alloy of the tin and the lead of the adjacent surface by applying heat between the melting point of tin-lead eutectic alloy and above the melting point of tin, but insufficiently above the melting point of tin to disturb the outer surface of the lead sheet to thereby impair its protective quality, and applying pressure.

7. The method of protecting an iron sheet with lead, a surface of said iron having a coating containing tin, which comprises, contacting the lead sheet with the coated surface of the iron, forming an alloy of the tin and the lead of the adjacent lead surface by applying heat ranging between the melting point of tin-lead eutectic alloy and slightly above the melting point of tin, and covering the exposed edges of the iron sheet with lead.

RANDOLPH W. SHANNON.