Oct. 7, 1941. A. A. KRAMER 2,258,327

COATED METALLIC SHEET

Original Filed April 24, 1937

Fig. 1.

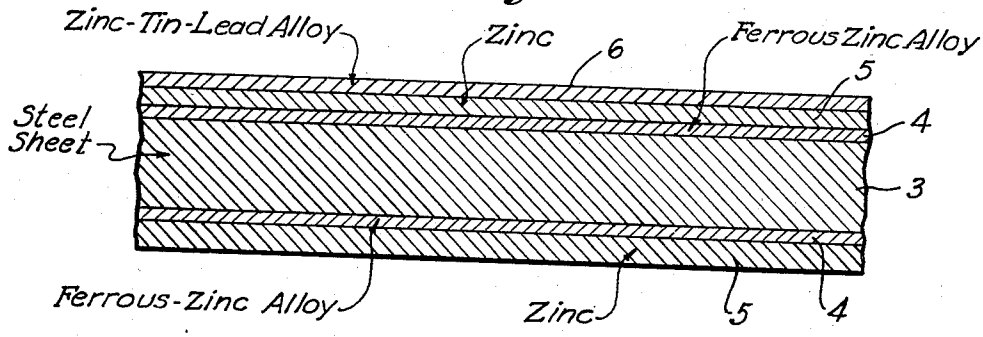
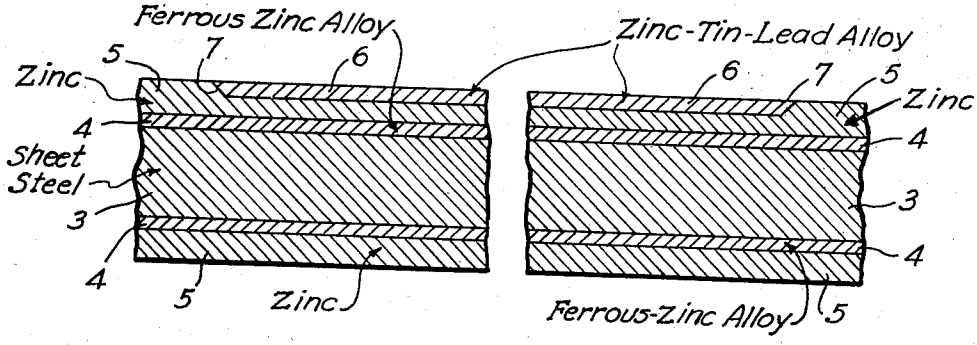


Fig. 2.



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COATED METALLIC SHEET

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Original application April 24, 1937, Serial No. 138,813. Divided and this application August 25, 1937, Serial No. 160,802

6 Claims. (Cl. 29—181)

My invention relates to coated metallic sheets provided with zones in which the same can be bent without damaging the coating. This is a division of my co-pending application Serial No. 138,813, filed April 24, 1937.

A difficulty that has always existed in the utilization of galvanized metal sheets has been that when such sheets, that had a heavy coat of galvanizing, were bent, the coating of galvanizing at the bend would crack and tend to flake, or peel off. As a result, even though the sheet as a whole was provided with a heavy galvanized coating over its entire surface before being fabricated, the bending of the sheet to form a flange, of a seam, would damage the galvanized coating on the sheet so seriously, that it would render the coating partially ineffective, where the bends required to form the flanges, or seams, were made, and consequently the advantage of the heavy galvanized coating on the sheet was largely lost. This was true, because, although the remainder of the sheet might be well coated and would not in any manner corrode, that portion in which the galvanized coating was caused to be damaged by the bending, would be hardly any better than an uncoated sheet, as far as resistance to oxidation, or other corrosion, is concerned. Attempts have been made to overcome this difficulty by galvanizing by a hot dipping process, after fabrication, but this entails many difficulties and requires very expensive equipment and is substantially impossible to successfully perform, where large sheet metal sections, such as tank sections, are fabricated and are to be protected from oxidation and other corrosion. It is the principal purpose of my invention to provide a sheet that is so treated before bending, that the bending will not injure the protective metallic coating on the same, even though a heavy coat of the protective metallic coating may be provided, and to provide a new and improved coated sheet that is provided with bending zones, in which bending can take plate at right angles, or even to the extent of doubling the sheet back on itself and forming a seam, without doing any damage to the metallic protective coating on the sheet. These zones may be made of any extent desired, and, while, preferably, only being provided at certain defined portions of the sheet, can extend over substantially the entire sheet, or over the entire sheet, if such is desirable.

The added metal can be applied anywhere desired on the sheet, in any configuration, or in any desired area and in any desired manner. It can be applied by contacting a solid piece of the metal, that is to be added, with the sheet and brushing, or spreading, with any desired implement, or can be applied in a finely divided powdered form, with any desired spraying, spreading, or sprinkling means, or can be applied with suitable means, such as a metal spray gun, in a molten condition. The metal that is applied must alloy with the zinc on the sheet to form a ductile, or flexible, coating on the sheet in the bending zone. It must be applied while the spelter, or zinc, is still in a molten state after passing through the galvanizing bath, and cannot be satisfactorily applied by re-heating of the sheets, because buckling of the sheets and oxidation of the galvanizing coating would then occur.

Other objects and advantages of my invention will appear as the description of my invention proceeds. I desire to have it understood, however, that I do not intend to limit myself to the particular details described, except as defined in the claims.

In the drawing:

Fig. 1 is a fragmentary sectional view on a greatly magnified scale, showing one form of my coated metallic sheet, and

Fig. 2 is a similar view partly broken away, showing another form of my improved coated sheet.

In making galvanized sheets, this is usually done by a hot submersion process, or dipping process, the metallic sheet of steel being passed through a bath of spelter, which is made up of, principally, zinc, although very small quantities of other metals are present, the best grade of spelter being about 99.5% zinc, and may contain very small fractional percentages of cadmium, or lead, and poorer grades of spelter ranging down to about 99% of zinc, with an increase in the lead, or cadmium content, as the case may be. As the melting point of the best grade of spelter is near 830° F., the bath for galvanizing is usually kept at a temperature between 840° F. and 850° F. As a result of passing the sheet through this bath, the temperature of the sheet, immediately after it leaves the bath, is above that of the melting point of zinc, or at about the melting point of zinc, which would be about 830° F.

When a sheet is galvanized, zinc in the galvanizing bath alloys itself with the iron of the steel in the sheet, and forms a very thin layer of a ferrous zinc alloy immediately adjacent the steel of the sheet. Inasmuch as this alloy has a much higher melting point than the spelter, or zinc, this immediately sets and thus prevents any further alloying action between the zinc and iron

of the steel, the remainder of the spelter forming a coating of almost pure zinc overlying the coating of zinc-iron alloy on the sheet. This outer coating of zinc varies in thickness considerably, depending upon how it is applied to the sheet. Sheets are provided with a heavy coating of galvanizing by repeated dipping, or running of the sheets through the galvanizing bath. The zinc coating, of course, does not have the tensile strength of the steel, nor the flexibility of the steel, and consequently when the sheet is bent the tendency is for the coating, particularly on the outer side of the bend in the sheet, to break apart, or crack, at least down to the zinc-iron alloy that forms the innermost coating on the sheet.

In the making of my improved sheets, I apply an additional metal thereto immediately after the sheets have emerged from the pot, or bath, in which the molten spelter is located, and through which the sheets have been passed, the coat of metal being applied, preferably, at the place where bending is to take place in the sheet when it is to be fabricated, and being applied before the molten metal of the galvanizing bath has set on the sheet. The metal can be applied by rubbing a bar of the metal on the sheet, or using pulverized metal, which is applied to the sheet by brushing or otherwise. The metal that is to be applied must be capable of alloying with the zinc on the sheet to form a ductile, or flexible, coating on the sheet. Any non-ferrous metal that has a low enough melting point and will alloy with zinc to form a flexible, or bendable, or ductile, coating on the sheet, can be utilized. I prefer to apply lead, or tin, or a solder made up of lead and tin, or what is known as an "aluminum solder" made up of tin and aluminum, to the sheet immediately after it leaves the galvanizing bath.

The application can be done by merely rubbing a bar, or block, or solid piece, of the metal across the sheet where it is desired to provide the alloy coating, spreading the same by wiping or brushing means of any desired character. It can be applied in a finely divided powdered state and brushed, or spread out, if this is desired, or it may be applied in a finely divided form by spraying it in a finely divided solid, or powdered, form on the zone on which it is desired to form the alloy, or it can be applied in a finely divided molten state by a suitable metal spray gun, or spraying apparatus.

The additional metal that is thus applied to form an alloy with the zinc, is applied in relatively small quantity in as finely divided and widely spread out condition as possible, it being, of course, necessary that sufficient of the alloying metal be applied, that the alloy will be formed throughout the zone in which it is desired to provide a ductile, or flexible, coating that will withstand the bending of the sheet without cracking, or breaking, of said coating. The portion of the coating that needs the greatest flexibility is, of course, that nearest the outer surface, because it will be subjected to the greatest tension, or compression, in bending. However, it is very desirable to have this characteristic of flexibility, or ductility, extend as far into the coating as possible. The important feature of my invention is the alloying of the zinc with the tin, or with the lead, or with the tin and lead in the solder, or with the tin and aluminum in the solder, that is applied while the sheet is still hot and the zinc coating is still in a molten condition.

My improved coated sheets can also be made by applying such metals as lead, or tin, or lead-tin solder, at temperatures lower than that existing immediately after the sheets leave the galvanizing bath, by adding a flux to the metal, or solder.

It has been found that in sheets made as herein described, a heavy coating of galvanizing so treated in the bending zones of the sheets, or in other words, in the zones in which the sheets are to be bent, will not crack or be in any manner broken by bending the sheet. It is, of course, to be understood that the size of the zone can be varied, as may be found desirable, up to the complete sheet, should this be found to be advantageous, and that any such areas, or zones, of bending in any configuration can be provided with the bendable, or flexible, alloy, as may be found desirable or necessary. It is, of course, to be understood that the application of the additional metal to the hot sheet, leaving the galvanizing bath, can only be performed after the last passage of the sheet through such a bath, where it is passed through a bath more than once, or through a series of galvanizing baths.

The added metal that forms the flexible alloy with the zinc may be applied on one or both sides of the sheet, as may be found desirable or necessary. In case only one side of the sheet is to be treated so as to obtain a flexible coating thereon in a bending zone, it would, of course, be necessary to apply the additional metal, forming the alloy with the zinc, to that side of the sheet that will be on the outside of the bend, as that will be the coated surface that will be put under the greatest tension and be the most liable to crack, or break, when the sheet is bent.

In Fig. 1 is shown a coated sheet that has a body portion 3 of steel, or similar sheet material, the ferrous zinc alloy coating that exists adjacent the steel of the sheet being indicated thereon by the numeral 4, the zinc coating by the numeral 5, and the zinc-tin-lead alloy coating being indicated by the numeral 6. In this form of the invention the coating of zinc-tin-lead alloy extends over the entire area of the sheet. In Fig. 2 a modification is shown, in which the various coatings are indicated by the same numerals. It will be noted, however, that in the form of the invention shown in Fig. 2 the zinc-tin-lead alloy coating is applied only to certain areas, or zones, of the sheet, terminating at 7, these being the bending zones, or other zones in which the fabrication takes place. The zinc-tin-lead alloy merges into the zinc coating at the boundary 7 of this zone and the major portions of the sheet have the zinc coating exposed, on the side of the sheet on which said bending zones are provided. It is, of course, to be understood that the number of bending zones, the width thereof and the spacing thereof can be as may be desired or required for the use to which the sheet may be put.

1. A steel sheet having a protective coating thereon comprising an inner ferrous zinc alloy zone adjacent the steel body portion of the sheet, an intermediate zone of substantially pure zinc, and an outer flexible zinc alloy zone extending to the exposed surface of said coating, said flexible alloy containing a relatively small quantity of a non-ferrous metal having a lower melting point than zinc and a relatively large quantity of zinc, said outer zone having a sufficient percentage of zinc therein to retain the corrosion resisting characteristics of a zinc coating at the exposed surface thereof.

2. A steel sheet having a protective coating

thereon comprising an inner ferrous zinc alloy zone adjacent the steel body portion of the sheet, an intermediate zone of substantially pure zinc, and an outer flexible zinc alloy zone extending to the exposed surface of said coating, said flexible alloy containing a relatively small quantity of lead and tin and a relatively large quantity of zinc, said outer zone having a sufficient percentage of zinc therein to retain the corrosion resisting characteristics of a zinc coating at the exposed surface thereof.

3. A galvanized metallic sheet having a bending zone having a thick coating of zinc and a flexible zinc alloy coating overlying said zinc coating forming the exposed surface of said bending zone, said alloy containing a relatively small quantity of a non-ferrous metal having a lower melting point than zinc and a relatively large quantity of zinc, said flexible coating having a sufficient percentage of zinc therein to retain the corrosion resisting characteristics of a zinc coating at the exposed surface thereof.

4. A galvanized metallic sheet having a bending zone having a thick coating of zinc and a flexible zinc alloy coating overlying said zinc coating forming the exposed surface of said bending zone, said alloy containing a relatively small quantity of lead and tin, and a relatively large quantity of zinc, said flexible coating having a sufficient percentage of zinc therein to retain the corrosion resisting characteristics of a zinc coating at the exposed surface thereof.

5. A steel sheet having portions thereof coated with a zinc galvanizing coating, comprising an inner zone of an alloy of iron and zinc and an outer zone of zinc only, and other portions thereof coated with a coating comprising an inner zone of an alloy of zinc and iron, an intermediate zone of substantially pure zinc and an outer zone of a flexible zinc alloy, said alloy containing a relatively small quantity of a non-ferrous metal having a lower melting point than zinc and a relatively large quantity of zinc, said flexible coating having a sufficient percentage of zinc therein to retain the corrosion resisting characteristics of a zinc coating at the exposed surface thereof, there being the same quantity of zinc per unit of area over all portions of said sheet.

6. A steel sheet having portions thereof coated with a zinc galvanizing coating only, and having bending zones coated with a zinc galvanizing coating and a flexible zinc alloy coating that overlies said zinc galvanizing coating and forms the exposed surface of said bending zones, said zinc coating being thinner where said alloy overlies the same than where said zinc coating alone is employed, there being substantially the same quantity of zinc per unit of area over all the portions of said sheet, said alloy comprising zinc, lead and tin throughout its thickness, and having a percentage of zinc therein at its exposed surface sufficient to retain the corrosion resisting characteristics of zinc at said surface.

ANDREW A. KRAMER.