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METHOD OF APPLYING PROTECTIVE COATINGS TO SHEETS

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4 Claims. (Cl. 91—68.1)

My invention relates to a method of applying protective coatings to sheets, and more particularly to a method of applying a protective coating to a galvanized steel sheet. This application is a continuation in part of my co-pending application Serial No. 144,029, filed May 21, 1937, patented March 21, 1939, Patent No. 2,150,929.

It is an important purpose of my invention to overcome the difficulty previously existing in using galvanized metallic sheets having a heavy coating of galvanizing, which was that the coating of zinc on the sheets would tend to crack, and peel or flake off at the bend when making a sharp bend. As pointed out in the above mentioned patent, the damage thus caused to the galvanizing coating, particularly where a heavy coating of galvanizing is provided on the sheet, will render the coating at least partially ineffective, where sharp bends, such as required to form flanges, or seams, are made, and as a result the advantage of the heavy galvanizing coating on the sheet is largely lost. This is true, as has been pointed out in said above mentioned patent, because, at such ruptures in a galvanized sheet, the sheet would be no better than an uncoated sheet in resisting oxidization, or other corrosion, at the point of rupture, although the remainder of the sheet would be well coated.

My invention has for its purpose the provision of a simple, but relatively inexpensive, method of providing means for protecting a sheet that has been fabricated, in a manner so as to prevent any corrosion thereof at a bend, or bends, or other damaged areas thereof, due to fabrication steps, even though the original zinc coating may have been damaged, or ruptured, in bending, or other fabricating operations.

It is a further important purpose of my invention to provide a protective coating, either at a bend or over the entire area of a galvanized metallic sheet, that will be more resistant to corrosion, due to certain causes, than the galvanized sheet was before such treatment, and even before any fabrication steps thereof that might have damaged the coating, were performed thereon, and which protective coating will resist every kind of corrosion equally as well, as does the galvanized sheet at the portions thereof that have had only the heavy galvanizing coating applied thereto prior to its fabrication. As the term is used herein, by fabrication is meant, any bending, cutting or punching operation, or any other operation, on a sheet, that may be performed on the sheet after the same has been rolled and galvanized.

My improved method of providing a protective coating can be utilized to cover the entire area of a galvanized sheet, particularly advantageously for use in a tank that is filled with liquid that may have an undesirable corrosive effect on the usual zinc coating provided on such sheet. In such case the entire inner surface of the tank sections, or sheets, fabricated to a shape and size and punched with suitable holes for securing the sections together, may be treated to make the same more resistant to corrosion, not only at the bends therein, if there are any in the section, but over the entire surface thereof exposed to such corrosion.

It is a particular object of my invention to provide means for curing a defect in the coating at a bend in a galvanized sheet, by treating the sheet in accordance with my method only on the outer side of the bends, which are made in the sheet in forming flanges, or seams, thereon, as the zinc coating is not injured on the inner side of the bend, inasmuch as the injury in the coating is due to the lack of tensile strength of the zinc, which causes the rupturing, or damaging, of the coating on the outer side of the bend.

The heavier the coating of the zinc provided on the sheet, the greater the difficulty in preventing cracking of the galvanizing or zinc coating, due to making a sharp bend in the sheet, or performing other operations on the sheet, that might rupture or crack the same, this being due to the fact that the tensile strength of the same is very much less than that of either the steel or the ferrous zinc alloy, which lies adjacent the steel of the sheet in a galvanized sheet. My invention not only entirely overcomes the difficulty resulting from the rupturing of the zinc coating at such a bend, or similar place, but makes the sheet more resistant to corrosion, even though the coating has been cracked, or ruptured, at the bend, at the places where the sheet is treated in accordance with my method, than it was prior to fabrication, being particularly resistant to corrosion due to the sulphur compounds present in oils and similar materials.

I accomplish this purpose by amalgamating mercury with the protective coating wherever it is desired to make the same more resistant to corrosion, whether it be only at a rupture in the galvanizing coating of such a sheet or over the entire surface of the sheet. Mercury, and amalgams of mercury, are particularly resistant to corrosion due to acids, such as sulphuric acid, and other acids, and are not affected by hydrogen sulphide, as is zinc. Considerable difficulty is

encountered in applying metallic mercury to a galvanized sheet to produce the amalgam coating, because of its extreme mobility and its high surface tension, which causes it to form globules, or drops, that run off the sheet, being thus difficult to handle and easily lost. By amalgamating lead with the mercury that is to be applied to the sheet, it can be applied in a much more satisfactory manner, and it is one of the important purposes of my invention to provide a protective coating on a sheet that has zinc thereon, by spreading or applying an amalgam of mercury and lead, or an amalgam of mercury and lead and tin, both of which freely amalgamate with mercury, to the surface to be protected.

It is a further purpose of my invention to provide such an amalgam that can be readily applied in the desired quantity to produce the protective coating desired, without destroying the crystalline structure of the zinc coating on a galvanized sheet, by merely spreading or rubbing the same on the parts of the sheet that are to be treated. In order to do this, I provide an amalgam of lead and mercury, or of lead, tin and mercury, that has the consistency of a soft putty, or is of a creamy character. If this is rubbed on the metal at the place where it is to be protected, such as a rupture in the coating on the sheet, a certain amount of the amalgam adheres to the surface of the sheet, both at the zinc coated area and the area where the coating has been ruptured. Due to the putty-like, or creamy, character of the amalgam, the excess can be readily removed with a cloth, or in a similar manner, and saved for future use.

It is a particular purpose of my invention to provide an amalgam of the above mentioned character, that can be applied to a sheet that has been previously galvanized, in such a manner that the amalgam will act on the zinc coating, so as to amalgamate therewith, so that a zinc-lead-mercury amalgam, or a zinc-tin-lead-mercury amalgam, is produced, which, while at first soft and capable of being rubbed off with the fingers, will, after twenty-four to forty-eight hours, be just as hard and have a similar appearance to the coating on the sheet before the amalgam was applied.

It is a further purpose of my invention to provide a method of making a protective coating for metals, which protective coating contains mercury, comprising the step of dissolving in mercury finely divided lead, or finely divided lead and tin, both of which readily amalgamate with mercury, in such proportions as to form a soft putty-like amalgam paste. The lead and tin can be simultaneously amalgamated with the mercury, by utilizing a lead-tin solder for this purpose, the solder being, preferably, although not necessarily, finely divided for amalgamation with the mercury. While this can usually be done at ordinary atmospheric temperatures found in the ordinary work shop, if any difficulty is encountered in dissolving the finely divided metal, such as lead, or lead and tin, or it is desired to increase the proportion of such metal, or metals, to be dissolved in the mercury, or to dissolve lead-tin solder that is not finely divided in the mercury, the mercury can be heated above the atmospheric temperature for this purpose.

Other objects and advantages of my invention will appear as the description of the same 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.

My improved method is carried out on galvanized sheets that have been fabricated to the desired size and shape, by bending, die-shaping, cutting and punching operations, or any of these that may be necessary to produce the article, or sections of an article, of the desired shape from the sheet of metal. After the sheet has been fabricated, it is cleaned at the places at which the protective coating is to be provided thereon, usually by means of dilute hydro-chloric acid, or a solution of tin chloride, or antimony chloride, or lead chloride, or zinc chloride, or cyanide of soda, to remove zinc oxide, oil and dirt from the galvanized sheet. This cleaning solution may be applied with a brush or swab of some character, and the excess may be removed with a cloth, or any other suitable means. When it is desired to apply the protective coating only at or adjacent a ruptured area on a galvanized sheet, or an area that may have been damaged to the extent of injuring the protective coating, or rupturing the same, the galvanized sheets are cleaned only on the outer sides of all bends therein, or any other area at which the coating may have been ruptured, or damaged, and areas adjacent these bends, or other areas where the damage may have occurred. A zone at the place at which the rupture in the zinc coating may exist will thus be cleaned, and also a zone on each side thereof.

A putty-like amalgam of mercury and lead, or of mercury and lead and tin, is made up prior to cleaning the sheets, or is made up in quantity to be used whenever necessary, said amalgam having such proportions of the metal, or metals, amalgamating with the mercury therein, to the quantity of mercury therein, as to produce a soft putty-like material of the consistency of thick paste, or cream. The proportions of mercury and lead, or of mercury and lead and tin, that are used to produce this soft putty-like material, will vary somewhat, dependent upon whether lead alone is used, or lead and tin is used, and also upon the atmospheric temperature existing, as the material must, of course, be of the soft creamy putty-like character at the temperature at which it is to be applied to the sheet. Thus in the winter time, when a lower temperature is encountered, both in the atmosphere and in the material of the sheets themselves, a larger proportion of the mercury to the lead, or lead and tin, must be used to produce the soft putty-like coating material. I have found that 65% of mercury and 35% of lead by weight will produce an amalgam of the desired consistency in the summer time, while in the winter time, when the temperatures are exceedingly low, it is frequently necessary to utilize an amalgam made for this purpose, that is made up of one part by weight of lead, to three or four parts by weight of mercury.

Substantially the same proportions are necessary where lead-tin solder is used, except in the case of a lead-tin solder which contains 33⅓% lead and 66⅔% tin, which solder has a lower melting point than does the tin contained therein. Such a solder can be combined with the mercury in the proportions of at least 40% of the solder to 60% of the mercury in the summer time, or under ordinary warm weather conditions, to produce such a soft putty-like amalgam as desired. The relative proportions of the metal, or metals, amalgamating with mercury, that have

to be utilized, are dependent upon the melting points of the metals that are amalgamated with mercury and the temperature encountered. Thus, if the mercury is heated when the lead is added thereto, as much as 50% lead can be included in the putty-like amalgam, and as much as 50% of a lead-tin solder, containing 33⅓% lead and 66⅔% tin can be included in an amalgam and produce a putty-like, soft creamy material for application to a sheet. If more than 50% of lead or such solder is amalgamated with the mercury while heated, the amalgam will not remain in a putty-like condition at the temperature at which it can be practically applied to the sheet.

In making up the putty-like, or creamy, paste-like amalgam, it is necessary that the lead that is to be dissolved in the mercury, or amalgamated therewith, is in a finely divided condition when it is to be amalgamated with the mercury. The lead can be in the form of any small particles, such as shavings, turnings, cuttings, or in the form of a powder or granules. The finely divided lead is stirred into the quantity of mercury that is to be utilized to make the amalgam in the proportions necessary, substantially within the limits above referred to. When a lead-tin-mercury amalgam is to be made, solder is ordinarily used for the lead and tin content of the amalgam, and if desired, the solder can also be utilized in such finely divided form as set forth above. If the solution, or amalgamation of the solder with the mercury, is to take place at a practical rate at room temperatures, such division into fine particles is necessary. If an unusually large amount of solder or lead is to be incorporated in the amalgam, it is necessary to heat the mercury to cause the material to be dissolved. Also if the solder is to be amalgamated with the mercury without finely dividing the same, or in other words, if relatively large pieces of the solder are to be dissolved, or amalgamated, with the mercury, the mercury must be heated to accomplish this in a practical manner. Inasmuch as the melting point of the solder is somewhat below that of the vaporization point of the mercury, heating up to the melting point of the solder can be utilized to get quick solution of the solder in the mercury, even if the solder is in a large piece, or large pieces, without loss of any of the mercury by vaporization. Whenever either the lead content, or the lead-tin solder content, desired in the amalgam, is above that readily amalgamating with the mercury at room temperature, the mercury may be heated for this purpose, keeping the temperature of the mercury well below that at which it would vaporize.

The soft putty-like amalgam of lead and mercury, or of lead, tin and mercury, produced as above described, is applied to the cleaned zone, or area, of the galvanized sheet, by a brushing or rubbing operation, the soft putty-like amalgam being brushed, or rubbed, onto the cleaned area of the sheet with a cloth, or in a similar manner. This rubbing or brushing operation spreads the lead-mercury amalgam, or the lead-tin mercury amalgam, as the case may be, over the cleaned area of the sheet and causes a thin layer thereof to adhere to the outer surface of the zinc coating on the sheet, and in case there is a rupture or damaged area in the sheet, from which the zinc has been entirely, or substantially entirely, removed, the lead-mercury amalgam, or lead-tin-mercury amalgam, as the case may be, will adhere to the sheet at this ruptured area also. As soon as the amalgam contacts the zinc coating on the sheet, it begins to act thereon to amalgamate the zinc in the zinc coating with some of the mercury in the amalgam. Accordingly, in brushing the amalgam back and forth over the ruptured area, some of the zinc of the galvanizing coating will be caused to be spread over the ruptured area, and any loose flakes, or particles, of zinc will be dissolved in the lead-mercury amalgam, or lead-tin-mercury amalgam, as the case may be, amalgamating with the mercury in such amalgam.

The action between the zinc and the lead-mercury amalgam, or the lead-tin-mercury amalgam, will continue until the amalgam has penetrated the entire zinc coating of the sheet down to, at least, the ferrous zinc alloy at the surface of the iron, or steel, of the sheet. As the zinc amalgamates with the mercury, the resulting amalgam will gradually become stiffer and harder, as the greater the amount of other metal amalgamated with the mercury, the harder and stiffer the amalgam will become. As a result, the penetration of the zinc by the lead-mercury amalgam will eventually produce a zinc-lead-mercury amalgam protective coating on the sheet over the entire surface to which the lead-mercury amalgam has been applied, which has lost the soft character of the lead-mercury amalgam and will become as hard as the zinc coating originally on the sheet. Similarly, the penetration of the zinc by the lead-tin-mercury amalgam will eventually produce a zinc-lead-tin-mercury amalgam protective coating over the entire surface to which this amalgam was applied, which has lost the soft character of the lead-tin-mercury amalgam, and will become as hard as the zinc coating originally on the sheet. It has been found that the use of an amalgam containing lead produces more rapid hardening of the amalgam coating on the sheet, than when a tin-mercury amalgam, for example, is used.

Thus, while the amalgam, when first placed on the sheet, will be soft enough that it can be rubbed off on the fingers to a certain extent, in the case of both the lead-mercury amalgam, and the lead-tin-mercury amalgam, after at least twenty-four hours, the coating at the area to which the amalgam has been applied will be hard enough that none of the same will rub off and the sheet can be handled without any damage to the coating, just as readily as was the case with the zinc coating on the sheet originally. In fact, the lead-mercury amalgam, or lead-tin-mercury amalgam, when utilized as above described, will produce a protective coating on a sheet that will be practically as hard as was the zinc coating on the sheet originally, before such treatment, at approximately twenty-four hours after application of the amalgam to the sheet. The sheet will, after the coating has become hard, have substantially the same appearance as it did before any amalgam was applied thereto, and none of the coating can be rubbed off, even though it may be rubbed persistently for a considerable period of time. The coating will have the characteristic spangled appearance of the zinc coating originally on the sheet. This indicates that the application of the putty-like amalgam to the sheet that has been previously galvanized, while resulting in the dissolving of the zinc on the sheet, in the mercury of the amalgam, does this in such a gradual manner that the liquefaction of the coating material on the sheet takes place at such a slow rate through the thickness of the zinc

coating that the structure of the zinc coating on the sheet is not altered, although the composition changes from substantially pure zinc to a zinc-lead-mercury amalgam, or a zinc-lead-tin-mercury amalgam, as the amalgamating process proceeds through the coating. The sheet will accordingly have substantially the same appearance two or three days after the amalgam was applied thereto as it had before any application of amalgam thereto.

While my improved method is particularly applicable for use to prevent corrosion at ruptures in coatings on galvanized sheets at bends therein, or similar places, it is obvious that under certain conditions it would be desirable to apply the cleaning step and the coating step, not only to the area of a sheet on the outer side of a bend at and adjacent the bend, but also to the entire surface of the sheet, that is innermost when it is put in place as a wall portion of a container that is subjected to the corrosive action of sulphuric acid, or other sulphur compounds, which are ordinarily found in oil tanks, or similar receptacles. These sulphur compounds cause a corrosive action on the zinc coating of the sheet as ordinarily provided in oil and similar tanks. However, by utilizing my protective coating, including the lead-mercury amalgam, or lead-tin-mercury amalgam, and applying it to the inner surface of an oil tank, or the sections of an oil tank, made up of sheets that have been bent, cut and punched, this undesirable corrosive action is avoided entirely.

The tendency of the sulphur compounds, when acting on either of the amalgam coatings described, is to cause the mercury in the amalgam to form a protective film on the surface that is exposed to the action of the dilute sulphuric acid, or hydrogen sulphide, or other sulphur compounds, this causing some slight loss of some of the other metals from the coating, such as the zinc, lead and tin, but the mercury arresting this loss substantially immediately, due to the film forming action that it has.

There is substantially no loss of mercury in the carrying out of my method, because, if there is any excess of amalgam applied to the sheet, such excess can be removed with a cloth, such as the cloth by means of which the putty-like amalgam has been rubbed on the sheet, and the part thus removed saved for use on another sheet or other portion of the sheet. While it is immaterial whether the amalgam coating is of the same composition throughout, it has been found that if the soft putty-like amalgams, above referred to, are utilized, some of the mercury in the amalgams will amalgamate with the zinc immediately, forming either a zinc-lead-mercury amalgam, or a zinc-tin-lead-mercury amalgam, as the case may be, and some of the lead-mercury amalgam, or some of the lead-tin-mercury amalgam, as the case may be, will be present without any zinc in it at first, this being on the top surface of the coating. However, if the amalgams above referred to are left in contact with the zinc coating for twenty-four hours, or more, and an excessive amount of the amalgam is not used, sufficient of the mercury will amalgamate with the zinc that all of the zinc will become amalgamated with the mercury, and the resulting coating will be, in the case of the use of a lead-mercury amalgam, a lead-zinc-mercury amalgam, and in the case of the use of a lead-tin-mercury amalgam, the resulting coating will be a zinc-lead-tin-mercury amalgam, from the outer surface thereof to at least the ferrous zinc alloy at the surface of the metal of the sheet. Due to the fact that the zinc requires a much larger amount of mercury to be amalgamated with the same to produce a soft putty-like amalgam, than does lead or tin, this amalgamation of the mercury with the zinc, when completed, causes the coating to have a hard character, similar to that of the zinc, instead of a soft putty-like character, such as the amalgams had before these were applied to the sheet.

When a putty-like amalgam containing 35% lead and 65% mercury by weight, is utilized for application to a galvanized sheet that has a coating thereon of zinc that amounts to one ounce per running square foot, or one-half ounce per square foot surface on each side of the sheet, the amalgam will contain approximately 74.4% zinc, 10.2% lead, and 15.4% mercury. If a putty-like amalgam containing 60% mercury and 40% by weight of a tin-lead solder that is made up of 33⅓% lead and 66⅔% tin by weight, is utilized for application to a galvanized sheet that has a zinc coating, such as above referred to, thereon, the amalgam resulting will contain approximately 70.85% zinc, 7.77% tin, 3.88% lead and 17.5% mercury. With a heavier coating of zinc, the percentage of zinc will, of course, be higher, and of course, the percentage of lead, or lead and tin, will be less in the case of an amalgam being used that contains a larger percentage of mercury. As in all cases the amount of zinc in the amalgam coating resulting on the sheet will be over 50%, the coating will retain the characteristics of a zinc coating to a considerable extent, but will be modified in its characteristics considerably by the mercury contained therein, and to a lesser extent by the lead, or tin and lead, contained therein.

What I claim is:

1. The method of increasing the resistance to corrosion of a galvanized metallic sheet having a damaged area in the zinc coating thereof produced by fabrication operations performed on said sheet after galvanization thereof, comprising the spreading of a soft, creamy putty-like amalgam containing lead and from 65% to 80% mercury by weight over and adjacent the damaged area of said sheet, and removing any excess of said amalgam therefrom.

2. The method of increasing the resistance to corrosion of a galvanized metallic sheet having a damaged area in the zinc coating thereof produced by fabrication operations performed on said sheet after galvanization thereof, comprising the spreading of a soft, creamy, putty-like amalgam containing approximately one part lead to two parts tin and from 50% to 80% mercury by weight over and adjacent the damaged area of said sheet, and removing any excess of said amalgam therefrom.

3. The method of repairing a rupture in the zinc coating of a galvanized metallic sheet, comprising spreading thereby a soft, creamy, putty-like amalgam containing from 65% to 80% mercury by weight and lead over the surface of said sheet at and adjacent said rupture, rubbing the resulting amalgam over said rupture, removing all excess amalgam from said sheet and permitting the resulting amalgamation, over the entire area over which the same was spread, to proceed undisturbed throughout the zinc coating of the area of said sheet having said amalgam applied thereto to a stage resulting in a hard amalgam coating over said area.

4. The method of making a corrosion resisting coating having the appearance of a galvanizing coating on a galvanized metallic sheet, comprising making a soft, creamy, putty-like amalgam principally of mercury, lead and tin, containing from 50% to 80% mercury by weight, from 16⅔% to 6⅔% lead by weight, and from 33⅓% to 13⅓% tin by weight, applying a thin coating of said amalgam to said sheet, removing excess amalgam from said sheet, and leaving said coating undisturbed until said amalgam penetrates and amalgamates with all the zinc on the area of said sheet having said amalgam applied thereto and said coating hardens after such complete amalgamation.

HENRY L. KOHLER.

CERTIFICATE OF CORRECTION.

Patent No. 2,255,979. September 16, 1941.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, second column, line 64, claim 3, for the word "thereby" read --thinly--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of November, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)