

UNITED STATES PATENT OFFICE

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MATERIAL AND METHOD FOR COATING METALS

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8 Claims. (Cl. 148—6.5)

This invention relates to water insoluble coatings formed upon metals for rust or corrosion prevention purposes preparatory to the application of a siccative coating.

5 The principal object of the invention to improve the art of treating ferrous metals, zinc, zinc alloys and the like by modifying the metal surfaces so that a uniformly distributed and water insoluble coating is integrally bonded to the metal surfaces.

10 A further object is to simplify treating compositions for forming bonded and water insoluble coatings on metals.

15 Another object of the invention is to simplify the method of coating metals.

Other objects, features and advantages will become apparent from the following description and appended claims.

20 This invention, in certain respects, relates to improvements in the composition and methods disclosed in the Westerfield et al. Patent No. 1,240,395, issued September 18, 1917, and, in certain respects, is a continuation-in-part of my co-pending application, Serial No. 235,451, filed October 17, 1938, for cleaning and coating metals.

25 It has long been known that a heated and dilute solution of phosphoric acid in the presence of dihydrogen phosphates of a metal other than that of the metal to be coated, when the phosphoric acid is properly balanced, i. e., when the relation between phosphoric acid, dihydrogen phosphate and monohydrogen phosphate (formed by hydrolysis of dihydrogen phosphate when the latter is dissolved in water), in solution in a coating bath is such that coating occurs with a minimum of etching or dissolving of the surface of the metal to be coated. Unless the bath is maintained in such proper balance, no satisfactory coating is produced. Such process requires several hours treatment at a temperature near the boiling point of water and requires that the surface of the metal treated be cleaned thoroughly to remove all rust, or corrosion products, oil, grease and other foreign matter. This process can be speeded up by using expediter or activator materials such as soluble compounds of copper, for example, copper carbonate, and mild oxidizing agents such as alkaline or alkaline earth, metal nitrates, nitrites, sulphites, and the like.

30 The coating finally formed is composed of a mixture of double salts of iron (ferrous) and another metal, monohydrogen phosphates and normal phosphates. The said other metal is a metal above iron in the electromotive series of the met-

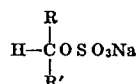
als. These double phosphates include residues of the activator materials employed, especially copper and copper compounds with the double normal phosphates predominating.

I have discovered that metals, especially ferrous metals, zinc and zinc alloys, and the like, may be effectively coated with a uniform, water insoluble coating integrally bonded to the metal surface without the use of near-boiling-point baths, without the use of metallic phosphate salts of any type, and without the use of the above activator or expediter materials. I have also discovered that the treating bath does not have to be kept within exacting limits as the proportions of constituents and no exacting "balance" between any combination or combinations of constituents needs to be obtained or maintained.

I have also discovered that a treating bath of a very simple constitution, each of the ingredients being usable within a wide range of limits, is very effective for coating metals. Such a treating bath may, for example, include from about 2 to 12 percent of 75% orthophosphoric acid, from 0.05 to 0.5 percent of a sulphonated wetting agent, and the balance may be water.

35 The metal etching and coating forming agent preferably employed is orthophosphoric acid, and this is employed in such proportions that in a diluted working solution there will be present, from about two to twelve percent, by volume, of 75% phosphoric acid.

The sulphonated wetting agent found most satisfactory for general use in coating producing and cleaning compositions is a sodium secondary alcohol sulphate which may be more specifically described as a sodium salt of an acid sulphate of a multiple carbon, saturated, branched-chain, secondary alcohol having the general formula:



40 wherein R and R' represent aliphatic hydrocarbon radicals and R plus R' contain a total number of carbon atoms ranging from 6 to 17. In commercial practice, such sodium secondary alcohol sulphates are sold in 25% concentration water solutions, by weight, i. e., twenty-five percent by weight of the sodium secondary alcohol sulphate and the balance water.

50 In the working solution, diluted with water, from about 0.3 to one percent of the water solution of such a sodium secondary alcohol sulphate is preferably employed. This makes the actual content of sodium secondary alcohol sulphate

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about 0.075 to 0.25 of one percent, and this in conjunction with from about two to twelve percent phosphoric acid and the balance water constitutes a workable coating forming composition for ferrous metals. The coating formed is produced by wetting the metal with such a composition and allowing the metal to dry, the coating being formed during the drying. The coating is apparently non-crystalline and is believed to be largely ferrous phosphate. It is uniformly distributed and substantially water insoluble. Except for a slight amount of loose powdery material at the surface, the coating is very adherent to the metal, as would be expected since it is merely a modification of the metal surface. No coating is formed while the metal is in the treating solution, but is formed during the air-dry. The phosphoric acid apparently causes the formation of the coating and, while the metal is in the treating solution, etches the same. The wetting agent enables the phosphoric acid to contact the metal, and during the drying operation to remain in intimate contact therewith until the acid has been completely expended, even though the metal treated had a light film of oil or grease on its surface when the solution was applied thereto.

In certain instances, as, for example, where heavy oil or grease films or other difficult to remove foreign materials are present on the metal surface, it is desirable to use a water miscible oil and grease solvent in the treating composition in the manner described in my co-pending application, Serial No. 235,451, filed October 17, 1938, for Cleaning and coating metals. Such water miscible oil and grease solvents may include acetone, monobutyl or monoethyl ethers of ethylene glycol, isopropyl alcohol, diacetone alcohol, and similar solvents or various combinations of such solvents.

Another sulphonated wetting agent which may be employed in about the same proportions as the sodium secondary alcohol sulphate is a sulphonated ester of a dicarboxylic acid, such as disclosed in the U. S. Letters Patent No. 2,028,091, and sold under the trade name Aerosol O. T. While a good coating is produced using this wetting agent, some difficulty has been experienced due to the fact that the treating material including this wetting agent, has a tendency to draw away from edges, points of sharp curvature, burrs and seams, of a metal article. While the effect of this may be at least partially overcome by adding a sugary substance such as molasses, dextrine and the like, or by rewetting and redrying the metal article, it is not always feasible to use either of these expedients in commercial practice.

Other sulphonated wetting agents which act fairly well, although, in general, requiring the use of larger proportions of wetting agent, are calcium or magnesium hydrocarbon sulphonates, aryl or aromatic sulphonates or sulphonic acids, long chain or fatty alcohol sulphates and fatty acid ester sulphates. Many other sulphonated and similar wetting agents have been tried; however, these, especially the sulphonated oils do not produce uniform coatings and do not appear to wet the metal uniformly. Saponin, a glucoside of vegetable derivation and gelatine will produce some coating but fail uniformly to wet the metal and do not cause production of uniform coatings.

The present treating composition is adapted to be used cold, i. e., at or about normal room temperatures and with metal reasonably free from oils or grease merely requires that the metal to be coated be wet with the treating composition

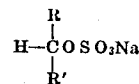
and then allowed to dry slowly, the treating composition acting chemically upon the metal during such drying to form the coating. On high grade cold rolled steels, especially those steels containing a considerable percentage of hard metals such as chromium, molybdenum, tungsten, etc., it is sometimes desirable to use a second application of treating solution and a second drying operation. In general, however, cast ferrous metals, hot rolled steels and the major portion of cold rolled steels coat satisfactorily when subjected to but a single application of the present treating solution and then allowed to dry.

It has been pointed out in my above mentioned co-pending application, Serial No. 235,451 that where the treating composition collects or is trapped or pocketed that at reacting solution of one concentration may be followed by a treating solution of a lesser acid concentration to redilute and utilize any free acid that might remain as the water dries out to insure completely coated articles. In certain cases a dilute ammonium hydroxide rinse or spray might be used in addition to or in lieu of such second treating solution to obviate any possibility of free acid remaining on the metal. As for example, a 0.2 of 1 percent solution of ammonium hydroxide may be used for this purpose. Heavier concentration ammonium hydroxide can also be used without throwing the coating produced over to the alkaline side, as apparently any excess ammonia and water evaporate as ammonia gas and water vapor, leaving the coating in a neutral condition. It is noted, however, that in general, any slight acidity of the coating is not harmful either to the adherence of paint or similar finishing material to the metal or to the life of the paint. The coating apparently decreases in acidity, in any case where acid is found, so that after standing a few days no indication of acid can be found. Where the coating is neutralized as above indicated, good adherence of the finishing material to the metal is also obtained.

It is to be understood that various changes in the ingredients, proportions of the same and in the methods of employing the above indicated materials may be made without departing from the scope and spirit of the present invention as defined by the appended claims.

What is claimed is:

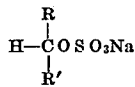
1. A composition for causing formation of a water insoluble coating on ferrous metals, comprising water, phosphoric acid and a sodium secondary alcohol sulphate.
2. A composition for causing formation of a water insoluble coating on ferrous metals comprising water, phosphoric acid and a sodium salt of an acid sulphate of a multiple-carbon, saturated, branched-chain, secondary alcohol, such salt having the general formula:



and wherein R and R' stand for aliphatic hydro-carbon radicals, R plus R' containing a total number of carbon atoms ranging from 6 to 17.

3. The method of coating ferrous metals which consists in treating the metal with a water solution of phosphoric acid and a sodium salt of an acid sulphate of a multiple-carbon, saturated,

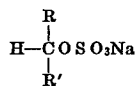
branched-chain, secondary alcohol, such salt having the general formula:



and wherein R and R' stand for aliphatic hydrocarbon radicals, R plus R' containing a total number of carbon atoms ranging from 6 to 17.

4. The method of coating ferrous metals which consists in treating the metal with a water solution of phosphoric acid and a sulphonated wetting agent, and then allowing the solution to dry on the metal.

5. The method of coating ferrous metals which consists in treating the metal with a water solution of phosphoric acid and a sodium salt of an acid sulphate of a multiple-carbon, saturated, branched-chain, secondary alcohol, such salt having the general formula:



and wherein R and R' stand for aliphatic hydrocarbon radicals, R plus R' containing a total number of carbon atoms ranging from 6 to 17,

and then allowing the solution to dry on the metal.

6. The method of coating ferrous metals which consists in treating the metal with a water solution of phosphoric acid and a sulphonated wetting agent, and then allowing the treating solution to act chemically upon the metal until substantially all the water has been slowly evaporated from the solution.

7. The method of coating ferrous metal which consists in treating the metal with a water solution of phosphoric acid and a sulphonated wetting agent and then with a dilute solution of ammonium hydroxide.

8. The method of coating ferrous metals which consists in modifying the metal surfaces by treating the same with a dilute water solution of phosphoric acid and a sulphonated wetting agent, then allowing the treating solution to act chemically upon the metal until substantially all the water has been slowly evaporated from the solution and produced a phosphate coating substantially integral with the metal surface, and then treating the coated surfaces with a dilute solution of ammonium hydroxide.

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