

UNITED STATES PATENT OFFICE

2,227,469

VAPOUR TREATMENT OF METALS

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Detroit, Mich.No Drawing. Application November 5, 1936,
Serial No. 109,303

16 Claims. (Cl. 148-6)

This invention relates to the field of chemically treating metal surfaces so as to increase their corrosion resistance and to provide thereon a coating to which paints, lacquers, enamels and the like adhere in a much firmer manner than to the untreated surfaces.

More particularly the invention comprises subjecting metal surfaces to the action of chromic acid vapor at a temperature which keeps the atmosphere filled with the vapors.

It has been proposed in United States Patent #2,046,633, to treat ferrous metals with a "chromic chloride" or "chromous-chloride" at temperatures ranging from 1650° F. to 1900° F. in an effort to provide a chromium and iron alloy. The process provides for the use of metallic chromium, chromite ore or ferro chromium mixed with sodium chloride or other chlorine containing compound, packing a ferrous metal article in such a mixture and heating to temperatures of approximately 1700° F., thus causing combination of chromium and chlorine in a gaseous form which permeates the metal treated.

CrO_3 volatilizes at approximately 450° F. and by the present invention the vapors are contained in an enclosed chamber into which the metal objects to be treated are inserted. The CrO_3 in dry form is contained within the chamber and the whole is heated by any known heating apparatus to a temperature ranging between 450° F. to 1000° F. The metal articles are placed within this enclosed chamber where the surfaces come into contact with the CrO_3 vapors which pervade the atmosphere. A coating is formed on the metal surfaces which is found to be composed principally of CrO_3 and Cr_2O_3 along with a comparatively small amount of the oxide of the metal being treated.

Other hexavalent chromium compounds may be substituted for CrO_3 , for example sodium chromate or sodium dichromate in combination with sulphuric acid or phosphoric acid may be used, and the resulting coating on the metal being treated will be composed principally of CrO_3 and Cr_2O_3 along with a comparatively small amount of the oxide of the metal being treated.

The coatings formed are found to render the surfaces extremely resistant to corrosion without any further treatment, and when rinsed in water, dried and finished with a sicative coating, provide protection against blistering and peeling of such finish as well as inhibiting creepage and oxidation around abrasions.

It has been discovered that metals generally

derive benefit from treatments in accordance with this invention and the term "metal surfaces" as used in the annexed claims is understood to mean one of the following iron, steel, zinc, galvanized metal, aluminum, stainless steel, rustless iron, lead, tin,terne plate, cadmium, nickel, copper and magnesium.

In practicing this invention the best results are obtained by using temperatures ranging between 450° F. and 1000° F.

The processing time needed for satisfactory results varies with the temperature used, the coating period being much longer at lower temperatures than at higher temperatures within the range specified.

The apparatus used for applying this treatment is capable of innumerable variations. It must be so arranged, however, that it will confine the vapors and so that they do not escape into the surrounding atmosphere where men are working. To achieve this end use may be made of cooling coils so arranged that they will condense excess vapors as they rise; or an exhaust fan to carry the vapors away from the surroundings while loading and unloading the enclosure with metal to be treated. Alternatively, one may provide only enough CrO_3 to treat a specific amount of work. Suitable apparatus will become obvious to those skilled in the art from the very nature of the process.

Although it is preferred that metal objects be cleaned before treatment, it has been found that greasy and dirty surfaces receive quite satisfactory treatments. As a result, less care need be taken in cleaning than is required with other known processes.

It is preferred also that the metal be allowed to reach approximately oven temperature before removing the same therefrom, as this heating of the metal aids in the formation of a coating composed of a larger quantity of insoluble Cr_2O_3 in place of condensed CrO_3 .

It has been discovered that the addition of certain other chemicals to the CrO_3 assists in vaporizing the CrO_3 at lower temperatures. For example, it has been found that the addition of chlorine compounds such as ferric chloride, sodium chloride, hydrochloric acid, or chlorates such as potassium chlorate, or a mixture of potassium chlorate and manganese dioxide have lowered the volatilization temperature considerably below 450° F. It has also been found that the coating may be rendered more insoluble and adherent by a subsequent baking operation be-

tween a temperature range of 450° F. and 1000° F.

It has been discovered further that various other substances may be vaporized and the metals above listed beneficially treated thereby. Nitrates such as ferric nitrate and manganese nitrate have been vaporized at temperatures under 1000° F., and coatings composed principally of oxides have resulted on metals treated therein, thus increasing their resistance to corrosion.

- 10 In all treatments provided for in this invention, it is preferred that the metal object after being treated be dipped or rinsed in either hot or cold water. This operation results in a more insoluble coating and is particularly advantageous when the objects are to be finished by painting or the like.

It is further recommended that after the water rinse, a final rinse be applied to the treated metal objects which consists in a dilute solution of chromic acid. The concentration of this final rinse may vary greatly, but for economy, sufficiently improved corrosion resistance has been obtained from a solution containing 4 grams per gallon of water. The chromic acid solution may be applied at a temperature ranging from room temperature up to boiling and a mere wetting of the surface is sufficient. The metal surface is then dried before applying a finish coat.

It will be seen from the foregoing description that the present invention comprises treating metal surfaces by subjecting them to the action of the vapors of CrO_3 or of a nitrate at a temperature of 1000° F. or below, such treatment having the effect of forming an oxide coating on and integral with said metal surfaces.

It is understood that the above detailed description is offered for the purpose of illustration and not with the intention of limiting the invention, the scope of which is to be determined by the appended claims.

It is within the scope of the invention to employ mixtures of the various materials used in this invention, for example, mixtures of CrO_3 and nitrates may be used, and when chlorine compounds are used to lower the volatilization temperature, more than one chlorine compound may be used in the process.

What we claim is:

1. A method of treating metal surfaces which comprises subjecting them to the action of vaporized chromic acid in combination with either ferric chloride, sodium chloride or hydrochloric acid.

2. A method of treating a metal selected from the group consisting of iron, steel, zinc, galvanized metal, aluminum, stainless steel, rustless iron, lead, tin,terne plate, cadmium, nickel, copper and magnesium which consists of subjecting said metal to the action of vaporized CrO_3 .

3. A method of treating a metal selected from the group consisting of iron, steel, zinc, galvanized metal, aluminum, stainless steel, rustless iron, lead, tin,terne plate, cadmium, nickel, copper and magnesium which consists of subjecting said metal to the action of vaporized CrO_3 and a chlorine compound, at a temperature below 1000° F.

4. A method of treating a metal selected from the group consisting of iron, steel, zinc, galvanized metal, aluminum, stainless steel, rustless iron, lead, tin,terne plate, cadmium, nickel, copper and magnesium which consists of subjecting said metal to the action of vaporized CrO_3 and thereafter subjecting such treated metal to the action of a solution containing chromic acid.

5. A method of treating a metal selected from the group consisting of iron, steel, zinc, galvanized metal, aluminum, stainless steel, rustless iron, lead, tin,terne plate, cadmium, nickel, copper and magnesium which consists of subjecting said metal to the action of a confined atmosphere containing vapor resulting from heating CrO_3 at temperatures ranging between 450° F. and 1000° F.

6. A metal article of manufacture having upon and integral with its surface a coating composed of oxides imparted through treatment in an atmosphere containing vapors resulting from heating CrO_3 and thereafter rinsing with a solution containing CrO_3 .

7. A metal article of manufacture having upon and integral with its surface a coating composed of oxides imparted through treatment in an atmosphere containing vapors resulting from heating CrO_3 and thereafter rinsing with water.

8. A method of treating metal selected from the group consisting of iron, steel, zinc, galvanized metal, aluminum, stainless steel, rustless iron, lead, tin,terne plate, cadmium, nickel, copper and magnesium which consists in subjecting said metal to the action of vaporized chromic acid obtained by heating a salt of chromic acid in combination with a mineral acid.

9. A method of treating a metal selected from the group consisting of iron, steel, zinc, galvanized metal, aluminum, stainless steel, rustless iron, lead, tin,terne plate, cadmium, nickel, copper and magnesium which consists in subjecting said metal to the action of vaporized chromic acid obtained by heating a salt of chromic acid in combination with phosphoric or sulphuric acid.

10. A method of treating a metal selected from the group consisting of iron, steel, zinc, galvanized metal, aluminum, stainless steel, rustless iron, lead, tin,terne plate, cadmium, nickel, copper and magnesium which consists in subjecting said metal to the action of vaporized chromic acid obtained by heating a salt of chromic acid in combination with a mineral acid at temperatures ranging between 450° and 1000° F.

11. A method of treating a metal selected from the group consisting of iron, steel, zinc, galvanized metal, aluminum, stainless steel, rustless iron, lead, tin,terne plate, cadmium, nickel, copper and magnesium which consists in subjecting said metal to the action of vaporized chromic acid obtained by heating a salt of chromic acid in combination with a mineral acid and thereafter rinsing with a solution containing chromic acid.

12. A method of treating a metal selected from the group consisting of iron, steel, zinc, galvanized metal, aluminum, stainless steel, rustless iron, lead, tin,terne plate, cadmium, nickel, copper and magnesium which consists of subjecting said metal to the action of vaporized CrO_3 and thereafter wetting the metal with a solution containing chromic acid, and drying the metal.

13. A method of treating metal selected from the group consisting of iron and steel which consists of subjecting said metal to the action of vaporized CrO_3 .

14. The method of producing a rust-proofing and bonding coat on a ferrous metal surface, which comprises oxidizing said surface with oxygen from a gaseous source at a temperature below 1000° F. for a period sufficient to form thereon a thin continuous adherent coating of iron oxides, wetting said coating with a dilute solu-

tion of chromic acid, and drying said solution on the surface.

15. The method of claim 14 to which is added the step of applying a finish coat selected from the class of paints, lacquers and enamels.

16. The method of producing a rust-proofing and bonding coat on a ferrous metal surface, which comprises oxidizing said surface with oxy-

gen from gases, which result from vaporizing nitrate, at a temperature below 1000° F. for a period sufficient to form thereon a thin continuous adherent coating of iron oxides, wetting said coating with a dilute solution of chromic acid, and drying said solution on the surface.

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