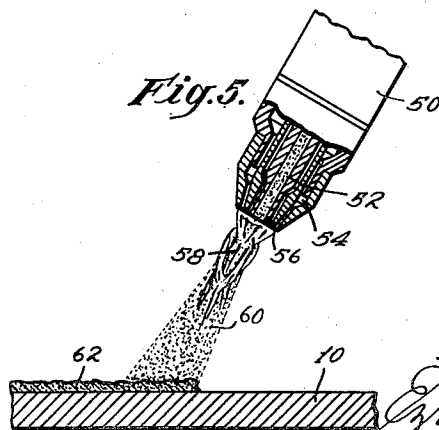
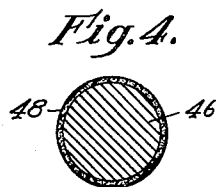
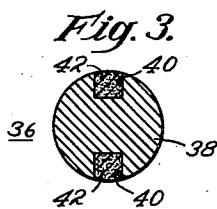
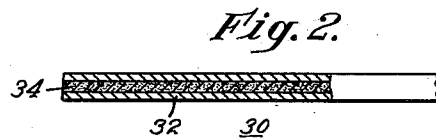
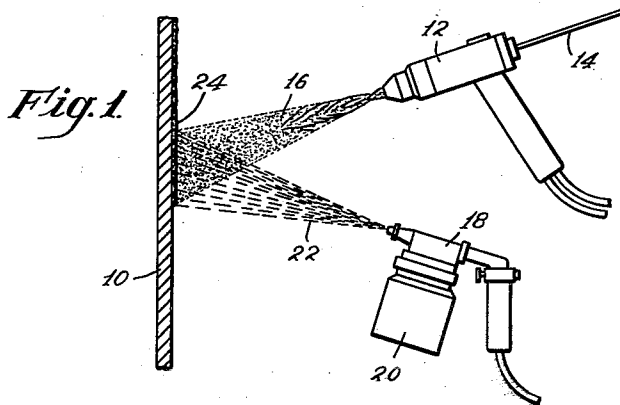


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SPRAYED METAL COATING

2,607,983

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SPRAYED METAL COATING

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This invention relates to protective coatings comprising sprayed metal for application to base members.

The object of this invention is to provide for applying to members highly protective sprayed metal coatings.

A further object of this invention is to provide for applying to members highly protective coatings composed of sprayed metals and a corrosion inhibitor embodied therein.

A still further object of the invention is to provide a composition composed of a sprayable and fusible metal and a corrosion inhibitor associated therewith.

Other objects of the invention will in part be obvious and will in part appear hereinafter. For a better understanding of the nature and objects of the invention, reference should be had to the following detailed description and drawing, in which:

Figure 1 is a view in elevation, partly in section, of one method of providing the protective coating of the invention;

Fig. 2 is a view in elevation, partly in section, of a sprayable rod member for carrying out the process of the invention;

Fig. 3 is a vertical cross section through a modification of a sprayable rod member;

Fig. 4 is a cross section through a particle capable of being sprayed; and

Fig. 5 is a fragmentary view in elevation, partly in cross section, of another form of apparatus for carrying out the invention.

In providing protective coatings on various base members, it has been found that sprayed metal alone is often subject to corrosion or premature failure because of the porosity of the sprayed metal coating when applied in reasonable thicknesses. According to the present invention, protective coatings of sprayed metal having exceptionally high protective value are produced by embodying in the sprayed metal a corrosion inhibitor. Suitable corrosion inhibitors are the corrosion resisting compounds of chromium such, for example, as the metal chromates and dichromates, and chromic acid and phosphates such as phosphoric acid and zinc phosphate. Typical corrosion resisting chromium compounds are sodium chromate, zinc chromate, zinc dichromate, lead chromate, and potassium chromate. The phosphates and chromium compounds may be employed individually or admixed in order to meet the requirements of the particular application.

Only a minor proportion of the protective

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coating need be composed of the corrosion inhibitor. As little as 0.1% of the inhibitor will give beneficial results, while 5% to 20% or more will produce excellent protective coatings. Discoloration of the metal base or the sprayed metal will be greatly retarded. Corrosion of the base metal will be reduced.

The corrosion inhibitor may be applied in a number of ways for incorporating into the coating of sprayed metal. A convenient method is to substantially simultaneously spray a solution of the corrosion inhibitor in a volatile solvent at the area where the metal is being sprayed on a base member. The heat from the sprayed metal will rapidly evaporate the volatile solvent present in the solution of the corrosion inhibitor, thereby leaving the corrosion inhibitor embodied in the sprayed metal coating.

Referring to Fig. 1 of the drawing, there is illustrated a base member 10 of a ferrous metal, such as steel for example, upon the surfaces of which a protective coating is to be applied. A metal spray gun 12, such as a Schoop spray gun, which may be heated electrically or by means of gas or other combustible material, and provided with a source of compressed gas to eject a spray of molten metal, is supplied with a wire or rod 14 of a suitable metal for producing a protective sprayed coating. The wire or rod 14, for example, may be composed of zinc, cadmium, aluminum, lead, copper, tin, nickel, Monel metal, stainless steels, such as 18% nickel and 8% chromium alloys, silver or other noble metal. In operation, the metal spray gun 12 creates a flame of an intense heat in which the wire or rod 14 is fused and is immediately subjected to a blast of air or gas, whereby the molten metal is projected as a spray 16 of fused metal. The gas may be such as to prevent oxidation of the metal spray. By suitably directing the spray 16, a coating of predetermined thickness and desired surface condition may be produced on the base member 10. The sprayed metal coatings may be less than 0.001 inch thick up to 0.025 inch heavy, and in extreme cases $\frac{1}{8}$ inch thick or heavier.

A conventional liquid spraying device 18, such, for instance, as a paint sprayer, provided with a container 20 carrying a solution of a corrosion inhibitor is operated to direct a spray 22 of the solution of corrosion inhibitor at the area 24 where the metal spray 16 is impinging, or just previous to, or just subsequent to the passage of the spray 16. The solution of corrosion inhibitor is preferably, but not necessarily, an

aqueous solution in order to avoid the hazard of a fire. A nonflammable organic liquid may be employed as the carrier.

A suitable solution of corrosion inhibitor for application with the sprayed metal is as follows:

Sodium dichromate -----	grams--	240
Sulphuric acid -----	do-----	2.4
Water to make -----	litre--	1

It will be found that heat from the sprayed metal will evaporate the water from the solution with this solution leaving sodium dichromate intimately associated with the sprayed metal particles.

Exemplary of the improvement produced by the practice of the invention two similar panels were prepared: One panel was sprayed with zinc alone using the spray gun 12 of Fig. 1; and the second panel also was coated with zinc except that a sodium dichromate solution in the above example was applied simultaneously with the sprayed zinc. When subjected to salt spray tests, the first panel with the coating of sprayed zinc alone thereon was crusted with white corrosion products in about 100 hours, while the second panel produced according to this invention was free from such corrosion products. After 576 hours in the salt spray cabinet, the first zinc coated panel was heavily crusted with white salts, whereas only a small fraction of the second panel had any white corrosion product present thereon.

It is not necessary to employ a solution of the corrosion inhibitor. The corrosion inhibitor may be embodied in the wire or rod of fusible metal which forms the base of the sprayed metal coating. The wire or rod may be associated in a great number of ways with the corrosion inhibitor, and both simultaneously fused and sprayed. It will be apparent that best results will be obtained if the corrosion inhibitor is fused, but it need not fuse and may be projected along with the molten spray metal as a finely divided powder.

Referring to Fig. 2 of the drawing, there is illustrated a wire or rod 30 suitable for use in spray gun 12 composed of a hollow tube 32 carrying the corrosion inhibitor 34 within the hollow. The tube 32 may be prepared from zinc, aluminum, lead, tin, copper, and silver or other noble metal. The corrosion inhibitor may be alkali metal chromate or dichromate, or other metal chromate, such, for example, as lead chromate, zinc chromate, or the corrosion inhibitor may be a zinc phosphate or the like.

The wire or rod may be coated with a thin surface layer of the corrosion inhibitor applied thereto as a paste or from a solution. Stranded wire may be coated by extruding thereon a pasty mixture of the corrosion inhibitor. If desired, the exterior coatings of corrosion inhibitor on the fusible metal wire or rod may be covered with a protective sheath composed of metal or a protective resin or the like.

In Fig. 3 of the drawing, there is illustrated the element 36 of wire or rod form suitable for use in a metal spray gun composed of a body 38 of the fusible metal such as zinc, lead, cadmium or the like provided with several grooves 40 carrying therein a supply of corrosion inhibitor 42. The element 36 may be fed into the spray gun 12 in the normal manner, and when sprayed from a metal spray gun will provide a spray composed of metal particles and fused particles of corrosion inhibitor. Upon impinging a base member and cooling, a protective coating having

unusually good protective characteristics will be secured.

The protective coatings of this invention can be applied by the spraying of fine powders of various metals, the powders carrying coatings of corrosion inhibitors, or otherwise associated with the inhibitors. Thus the metal powder may be admixed with powdered inhibitor. Several different powdered metals and one or more inhibitors may be coated thereon or admixed therewith.

In Fig. 4 of the drawing there is illustrated a greatly enlarged particle of a metal 46 such as aluminum, cadmium, zinc, or the like with a surface coating 48 of a corrosion inhibitor. The coating 48 may be produced by immersing the fine metal powder in a solution of the corrosion inhibitor and drying the wetted powders or else by dipping the metal powder in chromic acid or phosphoric acid whereby a reaction is produced leaving a phosphate or chromate coating on each particle. The treated powder may be applied by a suitable device such as a Schoop spray gun.

As shown in Fig. 5 of the drawing, the metal powders may be applied by means of the flame sprayer 50 having a central passage 52 for feeding the coated metal powder therethrough. The passageways 54 and 56 provide for a supply of combustible gas and compressed air in order to produce a flame 58 of sufficient temperature to fuse the metal powder and to project the molten particles as a spray. The fused metal powder enveloped in combusted gas is projected as a spray 60 against the metal surface base member 10 whereby a coating 62 composed of an intimate mixture of metal and corrosion inhibitor is deposited. The coating 62 of sprayed metal will be found to be tenaciously adherent to the metal surfaces of the base member.

Aluminum metal in powder form finer than 80 mesh was mixed with zinc chromate in an amount equal to 5% of the weight of the aluminum. Steel panels sprayed with the powder mixture produced a coating of an appearance equally attractive and otherwise similar to that secured with an all aluminum powder. However, on subjecting the steel panels to salt spray tests, it was found that after 100 hours the plain aluminum coating had not prevented the corrosion of the ferrous metal and the aluminum coating was covered with a heavy discoloration due to iron rust. The coating produced from the powdered aluminum containing 5% zinc chromate retained its original bright and undischored appearance, and it was apparent that it was capable of withstanding a much longer salt spray test without any adverse effects.

In another case zinc powder of a fineness of 100 mesh was mixed with 10% of its weight of powdered sodium dichromate. Steel panels were sprayed with the flame spray device shown in Fig. 5 to provide a coating of about 0.005 inch thick. Another set of steel panels were similarly sprayed with plain zinc alone. Accelerated corrosion tests were made of both sets of panels. After 200 hours in a salt spray test the plain zinc was thickly coated with a white film or corrosion products while the coating composed of zinc and sodium dichromate was clean and exhibited no apparent corrosion. When tested in a humidity cabinet at 100% relative humidity at 25° C., plain zinc coated panels were coated with a loose white powdery film. Panels coated with zinc plus 10% sodium dichromate were of a clean gray appearance and had no apparent corrosion.

While the sprayed metal coatings containing a

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corrosion inhibitor are applicable to almost any type of material, such, for example, as metals, ceramics, glass, wood, and the like, the protective coatings are most advantageous when applied to ferrous metals or other easily corrodable metals. Electrical apparatus exposed to the outdoors' atmosphere such as transformers, capacitors, switchgear, and the like may be protected to advantage by means of this invention. However, indoor and outdoor atmospheres will be resisted by hardware, machinery, household appliances and the like coated with the compositions herein disclosed. The corrosion inhibitor may function not only to protect the base metal such as iron or steel to which the sprayed metal coating is applied, but may furnish corrosion resistance to the sprayed metal itself. Thinner coatings may be applied to apparatus with as good protection as heavier coatings of sprayed metal without inhibitor.

While the corrosion inhibitor and sprayed metal coatings of this invention possess properties indicating their use as protective coatings proper, it will be appreciated that the compositions have advantages desirable for other purposes where weather resistance may be secondary. Thus in building up parts the enhanced corrosion resistance of the compositions imparts benefits not had by plain sprayed metal deposits.

Since certain changes may be made in the above invention and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or taken in connection with the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. An article of manufacture comprising, in combination, a ferrous metal base member and a protective coating applied to the surface of the base member, the coating comprising essentially sprayed porous metal and a corrosion inhibiting compound selected from the group consisting of phosphate and chromium compounds embodied both on the exposed surfaces and in the body of the sprayed metal.

2. An article of manufacture comprising, in combination, a metal base member and a protective coating applied to the surface of the base member, the coating comprising essentially sprayed porous metal and a corrosion inhibiting chromium compound embodied both on the exposed surfaces and in the body of the sprayed metal.

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3. An article of manufacture comprising, in combination, a metal base member and a protective coating applied to the surface of the base member, the coating comprising essentially sprayed porous zinc metal and a corrosion inhibiting chromium compound embodied both on the exposed surfaces and in the body of the sprayed metal.

4. An article of manufacture comprising, in combination, a metal base member and a protective coating applied to the surface of the base member, the coating comprising essentially sprayed porous aluminum metal and a corrosion inhibiting chromium compound embodied both on the exposed surfaces and in the body of the sprayed metal.

5. An article of manufacture comprising, in combination, a metal base member and a protective coating applied to the surface of the base member, the coating comprising essentially sprayed porous cadmium metal and a corrosion inhibiting chromium compound embodied both on the exposed surfaces and in the body of the sprayed metal.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,299,988	Metzger	Apr. 8, 1919
1,669,643	Andrews	May 5, 1928
1,971,804	Alexander	Aug. 28, 1934
1,978,115	Collins	Oct. 30, 1934
1,980,890	Tompkins	Nov. 13, 1934
2,110,717	Sellers	Mar. 8, 1938
2,121,574	Romig	June 21, 1938
2,206,502	Heligman	July 2, 1940
2,234,206	Thompson	Mar. 11, 1941
2,333,206	Sloan	Nov. 2, 1943
2,391,656	Tanner	Dec. 25, 1945
2,412,543	Tanner	Dec. 10, 1946
2,414,923	Batcheller	Jan. 28, 1947

OTHER REFERENCES

The Corrosion of Metals, pp. 204, 211-213, 1926, Pub. by Edward Arnold & Co., London, England. (Copy in Div. 3.)

Metal Finish pp. 148, 149, Apr. 1945. (Copy in Div. 14.)