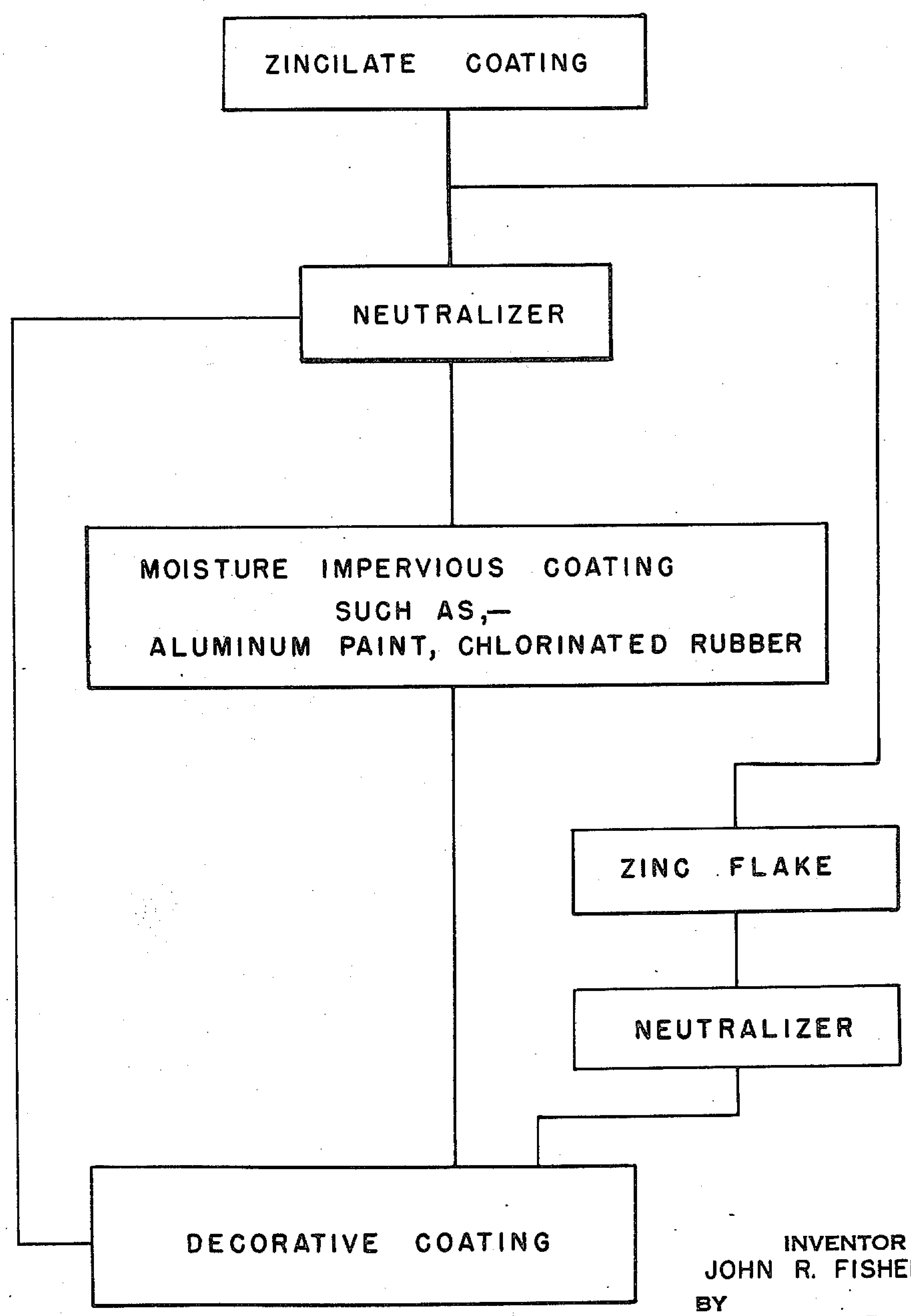
Feb. 6, 1951

J. R. FISHER, JR
METHOD OF COATING METAL AND
ARTICLES PRODUCED THEREBY
Filed Feb. 10, 1947

2,540,108



INVENTOR
JOHN R. FISHER, JR.
BY
Toulmin & Toulmin
ATTORNEYS

Patented Feb. 6, 1951 2,540,108

UNITED STATES PATENT OFFICE

2,540,108

METHOD OF COATING METAL AND ARTICLES PRODUCED THEREBY

John R. Fisher, Jr., Dayton, Ohio, assignor to Industrial Metal Protectives, Inc., Dayton, Ohio, a corporation of Delaware

Application February 10, 1947, Serial No. 727,489

8 Claims. (Cl. 117—70)

1

This invention deals with a method of applying a decorative coating to a protective coating of the metal dust-silicate type and with products obtained thereby.

So-called Zincilate coatings, which are such coatings of the metal dust-silicate type, are highly alkaline, and alkali is exuded to their surface. Decorative coatings applied to such highly alkaline coatings are usually greatly impaired by the alkali, for instance the oils of oil paints are saponified thereby.

It is an object of this invention to provide a combination of protective and decorative coatings and a method of preparing the same which are free from the disadvantage set forth above.

It is another object of this invention to provide metals with a protective and a decorative coating in which both coatings do not react with each other.

It is still another object of this invention to provide a protectively coated metal with a decorative coating wherein the said decorative coating is not attacked by said protective coating so that it has a relatively long service life.

It is still another object of this invention to provide metals with a protective and a decorative coating which are resistant to salt water, for instance to sea water.

These and other objects are accomplished by providing the protectively coated metal prior to applying said decorative coating with an intermediate neutral coating of a more or less high degree of impermeability.

The protective so-called Zincilate coating contains an alkali silicate of a specific gravity of from 1.28 to 1.30 and a $Na_2O:SiO_2$ ratio ranging from 1:2.3 to 1:3.0, a soluble chromate, and metal dust having particles so small that at least 90% thereof pass through a 400-mesh Tyler sieve but preferably of an average particle size of 3 microns or smaller. The production and composition of such protective coatings is the subject matter of the copending application Serial Number 727,490, filed February 10, 1947, of which the inventor of the instant application is a co-inventor.

It has been found that various methods and materials may be used for obtaining said intermediate coating. Thus, for example a neutralizing acid, preferably phosphoric acid, may be applied to the alkaline protective coating. In the case of phosphoric acid the alkali is neutralized and thus rendered harmless, and furthermore the metal of the protective coating reacts with the phosphoric acid under the formation of an insoluble metal phosphate. These reactions, in the

2

case of a zinc containing Zincilate coating, take place according to the following equation:

$$H_3PO_4+3NaOH=Na_3PO_4+3H_2O$$
$$2H_3PO_4+3Zn=Zn_3(PO_4)_2+3H_2$$

In addition to said phosphoric acid coating, a further intermediate coating may be applied. For the preparation of such an additional coating aluminum paint, a chlorinated rubber solution, or a zinc flake coating were found to be satisfactory. These additional intermediate coatings are especially advisable for cases where the metal is to be exposed to particularly strong attacking or surface corroding factors, for instance in the case where they are to contact sea water for a considerable period of time.

The insoluble zinc phosphate obtained with the neutralizer provides for a rather dense and impervious coating and thus prevents moisture that penetrates the pores of the decorative coating from carrying oil or other acid containing materials from said decorative coating into the Zincilate layer and thus a reaction between the acid of said decorative coating and the alkali of said Zincilate. However, if the metal articles are to be exposed to highly corrosive elements such as sea water, the decorative coating is attacked and deteriorates due to alkali of the Zincilate coating still having access to the decorative coating. In such events, the additional intermediate coating described above is advisable.

As the neutralizer, phosphoric acid is usable; however, an aqueous solution thereof having a concentration of not more than 2% is preferred. Instead of phosphoric acid, any other low concentrated acid which forms an insoluble salt with the metal of the protective coating may be used.

For the additional intermediate coating, an aluminum paint may be used which is based on a conventional varnish and which contains from 2 to 4 lbs. of aluminum flake per gallon of varnish.

The chlorinated rubber for the additional intermediate coating is preferably used in the form of a solution.

The zinc flake coating is composed similarly to the protective metal dust-silicate coating with the exception that metal flakes are used instead of metal dust. Compositions which were found satisfactory therefor contain:

Sodium silicate (sp. g. of about 1.3 and $Na_2O:SiO_2$ ratio of about 1:2.4)	gallons	1
Zinc flakes	pounds	2–4
Sodium chromate	grams	6–12

In contradistinction to zinc and other metal in powder form, the flakes of said last-mentioned intermediate coating leaf together and thus provide for a non-porous and impervious layer.

While the aluminum paint and chlorinated rubber coatings are applied after a neutralizer has been placed on the protective coating, a zinc flake coating is advantageously applied immediately on the protective coating and the neutralizer layer placed thereover.

The coatings may be applied by any conventional method known in the art; however, coating by spraying or brushing is preferred. Each kind of coating is immediately subjected to a drying step after application. The paint and rubber coatings have to be air dried or baked and vulcanized, respectively, the temperature of these steps depending upon the kind of compositions used in these coatings. For the zinc flake coating, a baking temperature of from 300 to 700° F. and a baking time for at least 1 hour are advisable.

The process is illustrated in the attached flow sheet which contains the various modifications set forth above. For the sake of simplicity and clarity, the drying and baking steps which follow each individual coating step have not been included there. Otherwise the flow sheet is self-explanatory.

Any of the modifications of my process yield coatings in which the protective and decorative layers do not react with each other and in which the decorative coating has an extremely long service life even when exposed to as corrosive a solution as sea water.

It will be understood that while there have been described herein certain specific embodiments of my invention, it is not intended thereby to have it limited to or circumscribed by the specific details given in view of the fact that this invention is susceptible to various modifications and changes which come within the spirit of this disclosure and the scope of the appended claims.

I claim:

1. In a process for coating metal the steps of depositing a layer of a coating composition comprising a dispersion of zinc dust having an average particle size of about 3 microns, at least 90% of which is capable of passing through a 400 mesh Tyler sieve in an aqueous solution of an alkali metal silicate containing soluble chromate, the ratio of alkali metal oxide to silica defined in moles being 1:2.3 to 1:3.0, setting the zinc dust-silicate coating, applying an acid solution to the set base layer which reacts with the surface of the alkali silicate layer and with the zinc metal therein to form a salt layer, the zinc salt portion of which is insoluble, drying the salt layer, and thereafter applying an oil base decorative coating to the dry salt layer.

2. In a process for coating metal the steps of depositing a layer of a coating composition comprising a dispersion of zinc dust having an average particle size of about 3 microns, at least 90% of which is capable of passing through a 400 mesh Tyler sieve in an aqueous solution of an alkali metal silicate containing soluble chromate, the ratio of alkali metal oxide to silica defined in the moles being 1:2.3 to 1:3.0, setting the zinc-dust silicate coating, applying an acid solution to the set base layer which reacts with the surface of the alkali silicate layer and with the zinc metal therein to form a salt layer, the zinc salt portion of which is insoluble, drying the salt layer, thereafter applying oil base decorative coating to the dry salt layer, and baking the multi-layered finish obtained.

3. In a process for coating metal the steps of depositing a layer of a coating composition comprising a dispersion of zinc dust, the average particle size of which is not larger than 6 microns and having an average particle size of 3 microns, at least 90% of which is capable of passing through a 400 mesh Tyler sieve in an aqueous solution of an alkali metal silicate containing soluble chromate, the ratio of alkali metal oxide to silica defined in moles being 1:2.3 to 1:3.0, the proportion of alkali metal silicate to zinc dust varying between 25%:75% to 29%:71% by weight, setting the zinc dust-silicate coating, applying an acid solution to the set base layer which reacts with the surface of the alkali silicate layer and with the zinc metal therein to form a salt layer the zinc salt portion of which is insoluble, drying the salt layer, and thereafter applying an oil base decorative coating to the dry salt layer.

4. In a process for coating metal the steps of depositing on clean metal surface a layer of coating composition comprising a dispersion of zinc dust having an average particle size of about 3 microns, at least 90% of which is capable of passing through a 400 mesh Tyler sieve in an aqueous solution of an alkali metal silicate containing alkali metal chromate, the ratio of alkali metal oxide to silica defined in moles being 1:2.3 to 1:3.0, setting the zinc dust-silicate layer by heating, treating the set silicate layer with a dilute aqueous solution of phosphoric acid of a concentration less than 2% which reacts with the surface of the alkali silicate layer and with the zinc therein to form a salt layer at least a portion of which is insoluble zinc phosphate, drying the salt layer, and thereafter applying an oil base decorative coating to the dry salt layer.

5. In a process for coating metal, the steps of depositing on clean metal surface a layer of coating composition comprising a dispersion of zinc dust having an average particle size of about 3 microns at least 90% of which is capable of passing through a 400 mesh Tyler sieve in an aqueous solution of an alkali metal silicate containing alkali metal chromate, the ratio of alkali metal oxide to silica defined in moles being 1:2.3 to 1:3.0, setting the zinc dust-silicate layer by heating, treating the set silicate layer with a dilute aqueous solution of phosphoric acid of a concentration less than 2% which reacts with the surface of the alkali silicate layer and with the zinc therein to form a salt layer at least a portion of which is insoluble zinc phosphate, drying the salt layer, applying a solution of a chlorinated rubber to said salt layer, drying and vulcanizing said rubber layer, and thereafter applying an oil base decorative coating to the dry rubber layer.

6. A ferrous metal article having on the surface thereof a hard protective coating resulting from the application thereto and the drying thereon of superimposed layers, the first layer comprising zinc dust of an average particle size of about 3 microns at least 90% of which is capable of passing through a 400 mesh Tyler sieve in an aqueous solution of an alkali silicate and alkali chromate, the ratio of alkali metal oxide to silica in the silicate defined in moles being approximately 1:2.3 to 1:3.0, the second layer of which consists of a dry salt at least a portion of which is insoluble zinc salt formed by re-

action of dilute acid on the surface of the zinc dust-silicate layer, and the third layer of which is an oil base decorative coating applied to the dry salt layer.

7. A ferrous metal article having on the surface thereof a hard protective coating resulting from the application thereto and the drying thereon of superimposed layers, the first layer comprising zinc dust of an average particle size of about 3 microns at least 90% of which is capable of passing through a 400 mesh Tyler sieve in an aqueous solution of an alkali silicate and alkali chromate, the ratio of alkali metal oxide to silica in the silicate defined in moles being approximately 1:2.3 to 1:3.0, a second layer of which consists of a dry salt at least a portion of which is insoluble zinc phosphate formed by the reaction of dilute phosphoric acid of a concentration less than 2% on the surface of the zinc dust-silicate layer, and a third layer of which is an oil base decorative coating applied to the dry salt layer.

8. A ferrous metal article having on the surface thereof a hard protective coating resulting from the application thereto and the drying thereon of superimposed layers, the first layer comprising zinc dust of an average particle size of about 3 microns at least 90% of which is capable of passing through a 400 mesh Tyler sieve in an aqueous solution of an alkali silicate and alkali chromate, the ratio of alkali metal oxide to silica in the silicate defined in moles being approximately 1:2.3 to 1:3.0, a second layer of which consists of a dry salt at least a portion of which is insoluble zinc phosphate formed by the reaction of dilute phosphoric acid of a concentration less than 2% on the surface of the zinc dust-silicate layer, and the third layer of which is vulcanized chlorinated rubber applied to said dry salt layer, and the fourth layer of which is an oil base decorative coating applied to the rubber layer.

JOHN R. FISHER, Jr.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,973,740	Andres	Sept. 18, 1934
2,076,869	Tanner	Apr. 13, 1937
2,088,140	Rosenthal	July 27, 1937
2,163,678	Gundlach	June 27, 1939

FOREIGN PATENTS

Number	Country	Date
15,131 of 1928	Australia	Aug. 17, 1928