June 3, 1947. G. R. SIMMONS 2,421,719

VITREOUS ENAMELLED ARTICLES

Filed June 6, 1942

FIG. 1

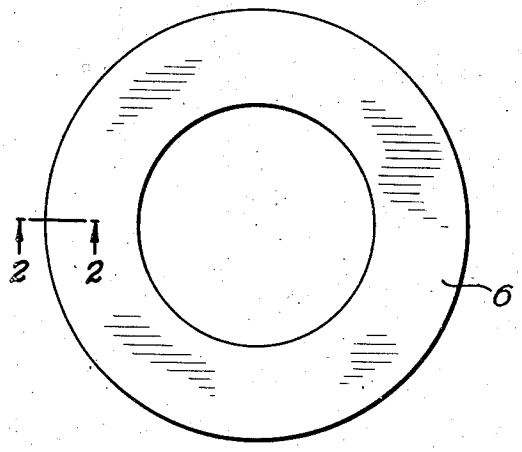
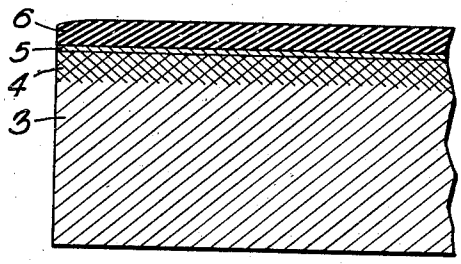


FIG. 2



INVENTOR
G. R. SIMMONS
BY Harry C. Duff
ATTORNEY

Patented June 3, 1947

2,421,719

UNITED STATES PATENT OFFICE

2,421,719

VITREOUS ENAMELLED ARTICLE

Glen R. Simmons, Chicago, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application June 6, 1942, Serial No. 446,117

3 Claims. (Cl. 117—70)

1

This invention relates to vitreous enamelled articles, and to a method of making the same.

In the manufacture of vitreous enamelled articles having a ferrous metal base and particularly in the manufacture of telephone number plates of this type, it may be desirable, in order to obtain a smooth enamel finish free from discoloration, to use an intermediate coating of some other material than that used for the base. It appears that a ferrous metal surface does not wet satisfactorily with enamel and, hence, adhesion is poor, and also that during the enamelling heat treatment, some of the iron present is converted into iron oxide which, mixing with the enamel, tends to discolor the enamel.

An object of the invention is to provide an article having a smooth and durable coating and an effective and efficient method of making the same.

In accordance with one embodiment of this invention, an article having a base of ferrous metal is provided with a coating of aluminum and then heated to cause some of the aluminum to alloy with the ferrous base and some to oxidize to form a ferrous aluminum surface having an aluminum oxide coating. A ceramic enamel is then coated on the article and the article heated to fire the ceramic.

Other objects and advantages will be apparent from the following detailed description taken in connection with the following drawings, wherein:

Fig. 1 is a plan view of a telephone dial number plate made in accordance with the invention and

Fig. 2 is an enlarged fragmentary sectional view taken along the line 2—2 of Fig. 1.

In the drawings, a telephone number plate coated with vitreous enamel in accordance with one embodiment of this invention is shown. The plate comprises a base 3 of ferrous metal. In preparing this base for a vitreous enamel coating 6, the base is given a thin coating of substantially pure aluminum. This coating may be obtained by hot dipping or electroplating or other processes which will produce a thin smooth coating. A thickness of the aluminum coating ranging from .0002 to .003 inch appears to be satisfactory. However, the thickness should be kept as thin as feasible and the precise thickness to be employed depends principally on the extent to which the aluminum can subsequently be readily alloyed with the ferrous base.

An aluminum oxide coating appears to present a satisfactory surface for vitreous enamelling. However, aluminum has a melting point slightly

2

over 1200° F., while ordinary vitreous enamelling processes are conducted at temperatures in excess of 1400° F. Obviously, the aluminum would be melted off during enamelling. Thus, in order to produce an aluminum oxide surface and at the same time a base which will be substantially unaffected by the heat used in the enamelling operation, the aluminum coated ferrous metal plate is heated to cause the aluminum to alloy with the ferrous metal and at the same time to form an aluminum oxide coating over the alloy layer.

In practicing this invention, the aluminum-coated plate is placed in an oven and heated to a temperature between 1600° F. and 1900° F. With a plate having an aluminum coating approximately .002 inch thick, excellent results are obtained by heating to a temperature of 1700° F. and heat treating the plate at that temperature for a half hour. During this heating period, the aluminum alloys with the iron and at the same time the aluminum which does not alloy with the iron is substantially completely oxidized, thus forming an aluminum oxide coating 5 over the surface of the ferrous aluminum alloy coating 4. Since the temperature at which this oxidation and alloying takes place is below the melting point of iron, it appears that the alloying is a result of atomic action, the action being greatly increased by the relatively high temperature.

It appears that one effect of the heat treatment in addition to those noted is that a large percentage of the carbon in the ferrous base is driven off as carbon dioxide and thus, in the subsequent enamelling operation, bubbling of the enamel surface, which may be due to carbon being driven off as carbon monoxide or carbon dioxide, is greatly reduced.

The coated plate may now receive a coating of enamel of the type commonly used in producing a ceramic or vitreous enamel finish on metallic articles. An enamel having the following composition gives satisfactory results:

	Per cent
Red lead	37.4
Pearl ash	5.6
Sodium nitrate	8.4
Arsenic oxide	5
Flint	38
Borax	5.6

This enamel is used in powder form and is spread over the surface of the article to be enamelled.

The enamel covered plate is then heated sufficiently to vitrify the enamel. With an enamel of the composition described, a temperature of approximately 1600° F. appears to give satisfactory results; however, with other enamel compositions, the desirable heat treating temperature may be somewhat lower or higher. By this process, a vitreous enamel coating on a ferrous metal base is obtained, the coating having excellent adherence, freedom from discoloration and freedom from bubbling.

With some types of enamel, a further improvement in adherence and freedom from bubbling may be obtained by coating the aluminum coated base with an aqueous solution of sodium silicate prior to the heat treating of the aluminum coated base in which the aluminum alloys with the base. A wetting agent, such as "aerosol" or any of the various wetting agents on the market, may be added to the sodium silicate to improve the adherence of the silicate to the aluminum. The plate is heated to a temperature above the temperature to which it is to be subsequently heated to fire the enamel. This is done to drive off the water from the sodium silicate, the water being removed to an extent dependent on the temperature used. Thus, with an enamelling temperature of 1600° F., if a temperature of 1700° F. is used to alloy the aluminum and ferrous base, the water in the sodium silicate will be sufficiently removed so that no water will be driven off during the subsequent enamelling heat treatment. Were water from the sodium silicate driven off during the enamelling, bubbling of the enamel would result.

The sodium silicate forms over the article a thin protective coating which is highly resistant to corrosion and fairly resistant to abrasion. At the same time, it impregnates the aluminum oxide and thereby produces a surface to which the subsequent vitreous enamel coating adheres very closely, the contact angle of the enamel on this type of surface being exceptionally small.

While but two embodiments of this invention have been shown and described, many modifications and alterations may be made without departing from the spirit or scope of the present invention.

What is claimed is:

1. An enamelled article comprising a ferrous metal base, said base having a ferrous aluminum surface, said surface having a coating of aluminum oxide, a coating of sodium silicate over the aluminum oxide coating, and a vitreous enamel coating over said sodium silicate coating.

2. A method of making an enamelled article comprising the steps of coating a ferrous metal base with aluminum, providing a coating of sodium silicate over the aluminum, heating the coated base to alloy the aluminum with the iron and to form a surface of aluminum oxide over the alloy and a surface of substantially dehydrated sodium silicate over the oxide, coating said base with a vitreous enamel, and firing to vitrify the enamel.

3. A method of making an enamelled article which comprises applying an aqueous solution of sodium silicate to a ferrous metal base having an aluminum coating, heating the article to a high temperature to alloy aluminum with the base material, form aluminum oxide and dehydrate the sodium silicate, coating the article with vitrifiable enamel, and then heating the article to a lower temperature to vitrify the enamel.

GLEN R. SIMMONS.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
510,340	Hines	Dec. 5, 1893
826,628	Thurston	July 24, 1906
177,953	Niedringhaus	May 30, 1876
2,101,950	McGohan	Dec. 14, 1937
2,115,855	Holman	May 3, 1938
2,167,701	Whitfield	Sept. 21, 1936

FOREIGN PATENTS

Number	Country	Date
463,790	Great Britain	Mar. 30, 1937