

1,583,006

Patented May 4, 1926.

UNITED STATES PATENT OFFICE.

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ENAMELING.

Application filed June 5, 1924. Serial No. 718,154.

No Drawing.

To all whom it may concern:

Be it known that we, HARRIE C. PIERCE and CHAD H. HUMPHRIES, citizens of the United States, both residing at Kokomo, in the county of Howard and State of Indiana, have invented certain new and useful Improvements in Enameling, of which the following is a specification.

Heretofore difficulty has been experienced in the enameling of certain metallic surfaces such as the electroplates of cadmium and zinc, due to the fact that the enamels on such surfaces after being baked show a marked tendency to flake off when subjected to light blows or even when scratched with the finger nail.

The object of the present invention is the provision of a process whereby this difficulty is overcome and the baked enamels are rendered firmly adherent.

The invention has particular reference to the enameling of cadmium coated articles and for convenience will be described in this connection.

We have found that by subjecting cadmium or cadmium plated surfaces to be enameled to the action of certain reagents a good adherence of the baked enamel may be secured, and its tendency to flake off when subjected to blows or abrasion is overcome. Thus far in our investigations we have found two materials capable of giving the desired results. These are sodium arsenate and sodium acid phosphate (Na_2HPO_4). While certain other materials which have been tested, for instance, ferrous sulfate, have given promising indications, none of them have, as thus far tested, given satisfactory results. We have therefore directed our attention particularly to the use of the water soluble arsenates and the water soluble phosphates, that is, to the oxygen compounds of the elements in the right hand column in Group V of Mendelejeff's classification of the elements, to wit, arsenic, phosphorus, antimony and bismuth.

The action of the phosphates and arsenates upon the metal surfaces which results in the firm adherence of the enamels thereto has not been definitely determined. The compounds are applied by subjecting the metal surfaces to relatively dilute and preferably warm solutions thereof. Aside from the

fact that the treatment renders enamels, which otherwise can be easily flaked off, firmly adherent, it has been noted that the metal surfaces, for instance bright cadmium plated surfaces, are considerably dulled by the treatment. It has also been noted that in order to secure equal results a somewhat longer treatment with dilute solutions than with more concentrated solutions is required, and also that a sodium arsenate solution when used hot gives the desired result more quickly than when used cold, while the effects of hot and cold solutions of sodium phosphate appear to be practically equal. Articles dipped into either the phosphate solution or the arsenate solution and then washed in hot water before being enameled give fairly good results, although not as good as when the dipped articles are permitted to dry without washing. Articles dipped into either solution and then dried can be washed for a considerable length of time in boiling water without losing the property imparted thereto by the action of the solutions, but the dulled appearance as well as the property of adhering to enamels are removed by protracted washing of the treated surfaces with boiling water. Very satisfactory results are obtained by treating articles first with either of the solutions and then applying the enamel while the surfaces are still wet. These observations give a basis for several theories as to the action of the solutions upon the metal surfaces, the most likely of which seems to be that the phosphates or arsenates react to some extent with the metals forming compounds therewith in the form of a film which in some way improves the adherence of the enamels. Contrary to this theory, although not conclusively disproving it, is the fact that the phosphates and arsenates are used up very slowly and require practically no replenishing.

The foregoing observations also indicate the preferred procedure for treating metal surfaces, which is as follows:

The metal articles to be enameled, for instance, bright cadmium coated iron or steel articles, are dipped into a solution of from 10 grams to 100 grams, preferably about 50 grams, of sodium arsenate or sodium acid phosphate per liter at a temperature of

about 80-100° F. and then dried in the air and enameled in the usual way. The articles should be thoroughly wetted by the solutions, but it is not necessary to maintain them in the solution for any prolonged period of time. With solutions of the concentrations indicated in the foregoing example it is only necessary to dip the articles and remove them immediately. However, if very dilute solutions are used it is necessary in order to get the maximum effect to hold the articles in the bath for a short period of time. If solutions of greater concentration or at higher temperatures than those indicated in the foregoing example are used there is a tendency for the arsenate or phosphate to crystallize upon the surface of the articles. This does not apparently help or hinder the enameling, but of course is objectionable in that it results in a waste of the salts.

Distilled or lime-free water should be used in preparing the phosphate solution in order to avoid the precipitation of calcium phosphate.

The effect of the treatment upon enameled articles is very striking. The enamels are distinctly more adherent than when the treatment is not employed, as may be found by comparative tests. The effect of the treatment is shown most clearly by dipping an article to be enameled only partly into the treating solution, drying it, and then coating it with the enamel. Before baking the enamel over the whole surface of the article appears the same but after baking there is a clear line of demarcation between that part of the enamel on the treated portion of the article and the enamel on the untreated portion. The enamel on the treated portion is darker and apparently smoother and more lustrous and is much more difficult to remove either by striking or by scratching.

The results obtained upon cadmium coated articles as described have been practically duplicated upon zinc coated articles.

We claim:—

1. In the process of enameling cadmium and zinc surfaces the steps which consist in treating the same with an oxygen compound of one of the elements in the right hand column of Group V of Mendelejeff's classification of the elements and then applying enamel to the treated surfaces.

2. In the process of enameling cadmium and zinc surfaces the steps which consist in treating the same with an aqueous solution of a soluble salt of an oxy acid of one of the elements in the right hand column of Group V of Mendelejeff's classification of the elements and then applying enamel to the treated surfaces.

3. Process of enameling cadmium and zinc surfaces which comprises contacting the same with a solution of an arsenate and thereafter applying enamel to the surfaces.

4. Process of enameling cadmium and zinc surfaces which comprises contacting the same with a solution of an arsenate, applying enamel to the surfaces, and baking the enamel.

5. Process of enameling bright cadmium coated articles which comprises treating the same with an oxygen compound of an element in the right hand column of Group V of Mendelejeff's classification of the elements and applying enamel to the treated surfaces.

6. Process of enameling bright cadmium coated articles which comprises dipping the same into a warm solution of sodium arsenate, drying the wetted surfaces, and applying enamel thereto.

In testimony whereof, we affix our signatures.

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