

UNITED STATES PATENT OFFICE.

ROBERT KENNEDY DUNCAN, OF WASHINGTON, PENNSYLVANIA.

ART OF DECORATING VITREOUS WARE.

SPECIFICATION forming part of Letters Patent No. 772,876, dated October 18, 1904.

Application filed February 2, 1904. Serial No. 191,748. (No model.)

To all whom it may concern:

Be it known that I, ROBERT KENNEDY DUNCAN, of Washington, in the county of Washington and State of Pennsylvania, have invented certain new and useful Improvements in the Art of Decorating Vitreous Ware; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improvement in the art of producing designs, ornamentations, or letters on articles, and more particularly to an improvement upon that for which Letters Patent were granted to me on the 5th day of January, 1904, and designated by No. 748,850.

The object of my present invention is to provide for the adjustability of the fusibility of the material with which the designs, &c., are made, according to the temperature of the article when the said material is applied thereto.

With this object in view the invention consists in certain novel steps in the method of decorating vitreous ware, as hereinafter set forth, and pointed out in the claim.

The improved material, which I have designated as "lead subborate," is made by fusing at a low temperature a mixture of a compound of lead, such as litharge or red lead or lead nitrate, with boric acid, either fused or crystalline, or the material can be made by precipitation. I have used all of the above substances and have ascertained that they are preferably used in approximately the following proportions: litharge, (PbO), 111.5, or red lead, (Pb_3O_4), 113.8, or lead nitrate, $\text{Pb}(\text{NO}_3)_2$, 165.5, mixed with boric acid, crystalline, (H_3BO_3), thirty-one, or boric acid, fused, (B_2O_3), 17.5. These substances mixed in the foregoing equivalent proportions yield an identical result with this exception, that when lead nitrate is used the color of the resulting product is somewhat improved.

Instead of using only one of the lead compounds referred to two of them may be mixed and used with advantage. Thus a mixture may be employed which consists of lead nitrate, 17.5, litharge, one hundred, and boric

acid, (crystalline,) thirty-one. The lead subborate produced by the fusion of any one of these several mixtures consists of a transparent highly refractive yellow-tinted glass-like mass and almost colorless in thin layers. It has, however, an extraordinary power of dissolving coloring materials—as, for example, metallic oxids—and the resultant may then present a very beautiful color. These coloring materials may be mixed with a "batch" of the lead subborate before fusion, or they may be mixed with the powdered borate and then fused therewith, or they may be mixed with the lead subborate as it lies fused in the pot.

The amount and kind of coloring-matter that is employed will depend on the kind and depth of color that may be desired. For example, the following proportions may be used for the production of blue ornamentation or lettering: litharge, one hundred and twelve; boric acid, thirty-four; cobalt carbonate, 2.6; nickel oxid, 0.1. For the production of emerald-green ornamentation, figures, or letters the following proportions may be employed: lead nitrate, 165.5; boric acid, thirty-three; cupric oxid, 3.2, and chromium oxid, 0.08.

Other colors—such as black, claret, copper, &c.—may be produced by using suitable inorganic oxids and salts. To produce an opaque enamel, the lead subborate is mixed with the oxids of antimony, arsenic, tin, &c., in the proper proportions. By mixing the enameling substances with the coloring substances an opaque colored enamel is produced. For example, the oxids of copper and cobalt mixed with the oxid of arsenic in the proper proportions will produce a turquoise enamel.

By very careful heating of the lead subborate it is possible to make it take the enamel condition without the necessity of adding any of the enameling-oxids, such as antimony, arsenic, &c.

Any one of the above-named mixtures of lead subborate and coloring material is put into a crucible which is highly refractory, and the crucible is then heated to a degree as low as possible to bring about a proper fusion of the mixture. The temperature is about that of a low red heat. The fused mixture is

poured from the crucible in a thin stream into
 cold water, with the result that it quickly so-
 lidifies and is transformed into a granulated
 powder. The granular powder is drained and
 5 dried and is then reduced to a fine impalpable
 powder in an agate mortar or by means of a
 mill employing agate rollers. The use of an
 iron mortar or iron rollers is objectionable,
 because the hard borate would under such con-
 10 ditions take up enough of the iron to ruin its
 color. Hence a mortar or rollers made of
 agate or equivalent material should be em-
 ployed for this purpose.

The lead subborate is vitreous, transparent,
 15 and brilliant. It is capable of being rendered
 non-transparent or enamel-like. It is practi-
 cally insoluble in hot or cold water. Its coeffi-
 cient of expansion and contraction is approxi-
 mately the same as glass, so that when applied
 20 it will not break or crack to pieces. It has
 the power of dissolving metallic oxides and
 salts to produce any desired colors. It unites
 chemically with glass and causes the designs
 or letters to be securely and permanently
 25 united therewith. It is capable of being re-
 moved from the glass. It is comparatively
 inexpensive to manufacture and may be ap-
 plied at slight cost and without materially de-
 laying the ordinary process of manufacture,
 30 and it is capable of fusion at a temperature
 not higher than the maximum temperature of
 the leers of annealing-ovens.

The preferred proportions of lead oxid and
 boric acid for the production of lead subbo-
 35 rate are such as will contain the maximum
 quantity of lead to boric acid—that is to say,
 about 111.5 of lead oxid to thirty-one of crys-
 tallized boric acid or 17.5 of melted boric acid.
 If the proportion of lead is increased beyond
 40 that above stated, it comes down in the me-
 tallic condition, and hence would be useless
 for the purpose set forth. By increasing the
 proportions stated of boric acid the compound
 is rendered less fusible; but the proportion
 45 may be increased to some extent above the
 proportion stated without rendering the com-
 pound too infusible for the purpose stated.
 Hence I do not restrict myself to the precise
 relative proportions stated, as they may be
 50 varied within certain limits and yet insure
 the desired result.

In the manufacture of glass articles—as, for
 instance, glass bottles—the glass is blown or
 pressed into molds. In the case of blown
 55 ware the intervals between the molding of
 the articles are of some duration. In the
 smallest pressed ware they come out of the
 molds at, say, a maximum rate of about ten
 a minute. The ware of all kinds is invariably
 60 taken from the molds while still red-hot in
 spots. The lead subborate, owing to its low

fusibility, instantly melts when placed in con-
 tact with glass that is barely red-hot and is
 applied to the bottle or other article imme-
 65 diately after it is removed from the mold, with
 the result that it melts and unites with the
 surface of the article. It has been found,
 however, that the temperature of the ware at
 the time the decorations are placed thereon
 will vary according to the character thereof—
 70 that is to say, whether the ware is blown or
 pressed and whether it is flint, opal, &c. For
 this reason it is important to adjust the fusi-
 bility of my improved decorating material in
 order that it can be properly applied to the
 75 ware when the latter has a certain tempera-
 ture at the time at which the material is to be
 applied to said ware. To accomplish this, I
 add to the material a substance which will
 render it less fusible, and the quantity of this
 80 substance (small in any case) can be readily
 determined by the known temperature of a
 certain kind of ware at that part of the pro-
 cess of making the same when it is most de-
 sirable to apply the decorating material. 85
 There are various substances which might
 constitute such a governor—such, for instance,
 as baryta.

The material may be applied to the ware
 by the use of stencil-plates or in any other
 90 desired manner. The comminuted material
 upon contact with the hot ware will quickly
 melt and produce the lettering or design
 formed of a smooth, brilliant, vitreous sur-
 face, the outlines of which are maintained
 95 sharp and clearly cut by the walls of the
 stencil-plate, as the material will not flow
 after the stencil shall have been removed, es-
 pecially when the fusibility of the material
 has been properly governed, as before ex- 100
 plained.

Having fully described my invention, what
 I claim as new, and desire to secure by Letters
 Patent, is—

The herein-described method of decorating 105
 vitreous ware, consisting in depositing upon
 a heated vitreous article, a compound result-
 ing from the chemical reaction of boric acid
 and lead oxid, each in the proportion sub-
 110 stantially as specified and adding to said com-
 pound before application thereof to the heated
 article, a substance regulating the fusibility
 of the said compound according to the tem-
 perature of the vitreous article to be deco-
 115 rated.

In testimony whereof I have signed this
 specification in the presence of two subscrib-
 ing witnesses.

ROBERT KENNEDY DUNCAN.

Witnesses:

ALVAN DORMAN,

MINNIE A. LEONARD.