

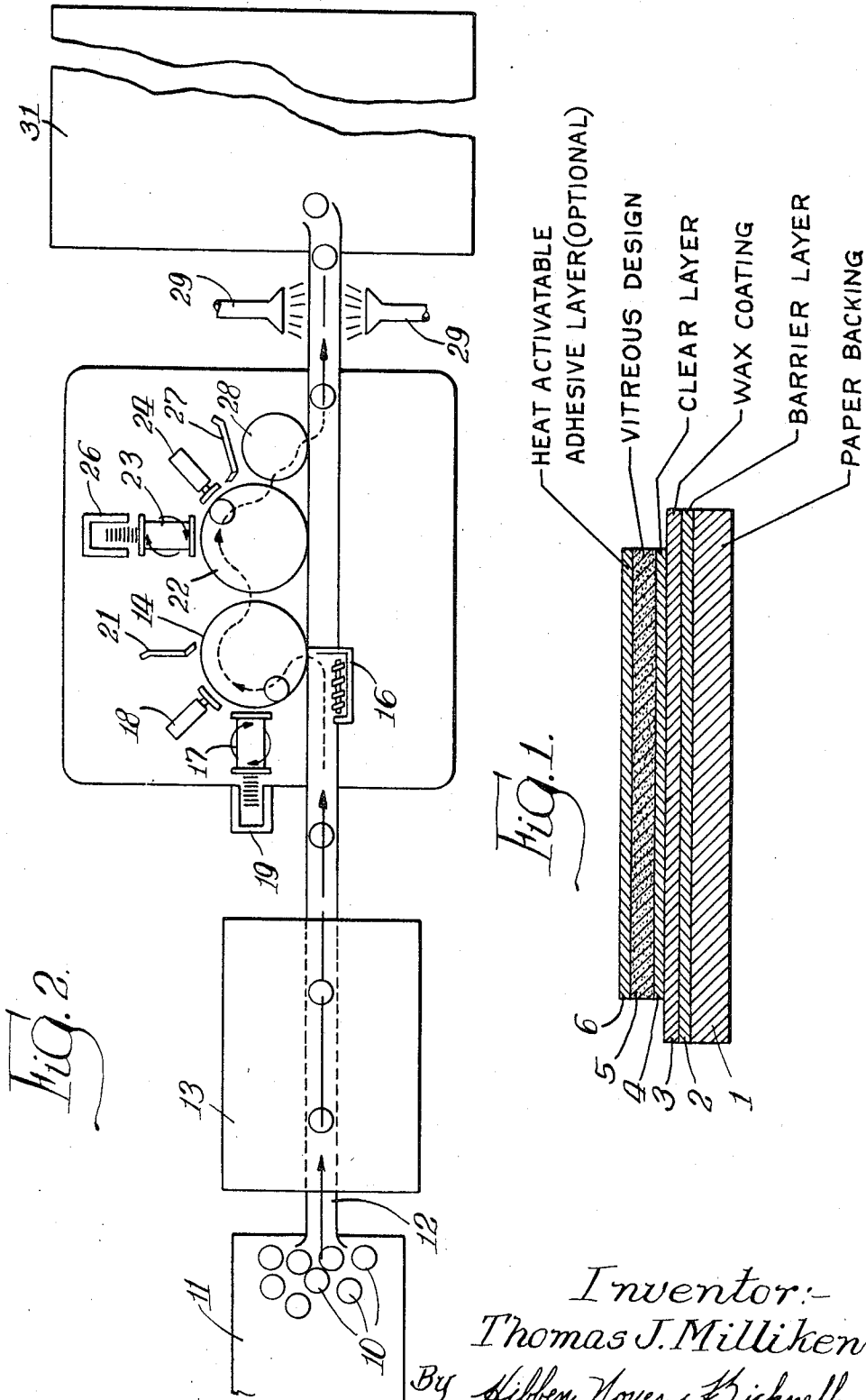
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T. J. MILLIKEN

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METHOD OF APPLYING A VITREOUS DECALCOMANIA

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Inventor:-
Thomas J. Milliken
By *Hibben, Hayes & Bicknell*
Attys.

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METHOD OF APPLYING A VITREOUS
DECALCOMANIA

Thomas J. Milliken, Chicago, Ill., assignor to The
Meyercord Co., Chicago, Ill., a corporation of Illinois
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10 Claims

This invention relates to improvements in the decoration of ceramic or vitreous articles, such as chinaware, glassware, pottery, porcelain ware, and the like, by means of a heat-release vitreous or ceramic decalcomania.

For many years, it has been customary to use decalcomania transfers prepared with special vitrifiable or ceramic colors in the decoration of articles of glassware, chinaware, or the like. For example, water release decalcomanias have been widely used which are either of the slide-off type or the varnish-applied duplex paper type, both of which will be familiar to those skilled in the art. In either case, soaking with water is necessary to effect separation of the backing from the design. After the design has been temporarily adhered to the ceramic article it is necessary to dry the article thoroughly to remove all traces of water after which a high temperature firing operation is employed in the usual manner.

Although water release vitreous decalcomanias have previously enjoyed extensive commercial use, it is well recognized that they have serious disadvantages arising primarily from the fact that a number of inconvenient and time-consuming manual steps are required. Furthermore, the use of water or varnish and the presence of water soluble gum introduces innumerable difficulties so that the water release transfers require considerable care and skill in the use thereof and do not lend themselves to high speed machine application.

In order to overcome the various disadvantages of the water release vitreous decalcomanias, there has been widespread commercial use in recent years of a heat release type vitreous or ceramic decalcomania, e.g. as fully described in U.S. Patents Nos. 2,970,076 and 3,007,829. A heat release vitreous decalcomania is characterized by the use of a heat releasable backing at the face or front side of the vitreous design layer and an outermost thermoplastic or heat activatable adhesive surface at the opposite or rear side of the vitreous design. When the outermost thermoplastic or heat activatable surface of the decalcomania is pressed against the surface of a preheated vitreous or ceramic article, the heat of the article is sufficient to activate the adhesive surface of the decalcomania so that the design is temporarily adhered to the article being decorated, and at the same time the heat of the article is sufficient to soften or melt the heat release layer of the backing, thereby effecting release of the backing from the design layer. Both effects are accomplished in substantially a single application step in which the decalcomania is pressed against the preheated ware by means of a pressure platen or the like. Usually, the released backing sheet can then be fully disengaged from the article by means of a jet of air or the like. The ware with the temporarily adhered vitreous design layer is then fired in the usual manner so that the vitreous design becomes an integral part of the surface of the article.

As described more fully in the aforementioned U.S. Patents Nos. 2,970,076 and 3,007,829, the preferred heat release material for the backing is a normally solid high molecular weight polyethylene glycol or a mixture thereof. These synthetic wax-like materials are sold under the name Carbowax compounds by Union Carbide Corporation, Chemicals Division. However, a difficulty is encountered on occasion in the use of Carbowax heat release vitreous decalcomanias in that during firing of the ware with the temporarily adhered design, distortion of

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the design sometimes occurs. In order to obtain consistent and reliable results with decalcomanias of this type it is necessary that the difficulty with distortion of the design be eliminated.

Accordingly, a primary object of the present invention is to provide a novel and improved method of decorating vitreous or ceramic ware using a heat release decalcomania of the type having a heat release material comprising a normally solid high molecular weight polyethylene glycol.

A further object of the invention is to eliminate design distortion during firing as heretofore encountered in the decoration of vitreous or ceramic ware with heat release decalcomanias of the aforementioned type.

Other objects and advantages of the invention will become evident from the subsequent detailed description taken in conjunction with the accompanying drawing, wherein:

FIG. 1 is a diagrammatic cross-sectional representation, on an exaggerated scale, of a vitreous decalcomania transfer of the heat release type used in the present invention; and

FIG. 2 is a schematic view of a decorating line as used in practicing the invention.

Referring to FIG. 1, the releasable backing of the heat release vitreous decalcomania illustrated therein includes a paper sheet 1 having a barrier layer or coating 2 which renders one side of the paper less porous and retards penetration by molten wax or wax-like materials. Various inorganic seal coatings, such as starch, casein, glue, an alkali metal silicate with or without a clay filler, etc., may be used as the barrier layer 2, but an organic barrier material is preferred, particularly polyvinyl acetate. Superimposed over the barrier layer 2 is a coating 3 of a wax-like heat release material comprising at least one normally solid high molecular weight polyethylene glycol. For example, the materials known as Carbowax 4000 and Carbowax 6000 sold by Union Carbide Corporation, Chemicals Division are particularly useful, as more fully described in the aforementioned U.S. Patent No. 2,970,076. Also, certain mixtures of Carbowax compounds are advantageous, as described in the aforementioned U.S. Patent No. 3,007,829.

By reason of the heat release layer 3, the remainder of the decalcomania (comprising the layers 4, 5, and 6) is releasable as a unit from the backing. The layer 4 is an unpigmented clear resinous film disposed over the heat release coating 3 and serves as an imprint-receiving support for the subsequently applied vitreous design. The vitreous design, indicated at 5, is disposed directly against the clear layer 4, it being understood that the design 5 may comprise either a single layer or, more often, a compound or composite layer including a plurality of different ceramic color compositions arranged to provide the desired ornamentation or text matter. If desired to impart strength and integrity to the design layer 5 or to provide an outermost surface that can more readily be rendered tacky or adhesive, another layer 6 may be disposed over the vitreous design 5. The layer 6 may be a clear layer of resinous material having thermoplastic properties or a layer of special heat-activatable thermoplastic adhesive material. In some instances, the layer 6 may be omitted and the thermoplastic properties of the resinous ingredients of the design layer 5 are relied upon to obtain temporary adherence of the design to the ware.

The clear resinous layer 4 which provides a base or support for the vitreous design 5 is preferably formed from the same general type of organic medium or vehicle which provides the body portion of the various color prints in the vitreous design 5. More specifically, the film 4 comprises the residue from a lacquer containing a

resinous film-forming ingredient, a solvent, and, in some cases, a plasticizer. The resinous film-forming ingredient is ordinarily a cellulose ester or ether (such as ethyl cellulose, cellulose acetate, or nitrocellulose) or an acrylic resin. The preferred materials are ethyl cellulose and the acrylic resins. For the decoration of glassware, the methacrylate polymers give best results, particularly n-butyl methacrylate polymer, isobutyl methacrylate polymer, and copolymers of the same. Any suitable solvent system may be employed, but in the case of ethyl cellulose the preferred solvent is one of the ethylene glycol ethers, such as ethylene glycol monobutyl ether, and in the case of the acrylic resins the preferred solvents are aromatic petroleum hydrocarbon solvents, such as toluene and xylene fractions. Suitable plasticizers, such as castor oil, dibutyl phthalate, or chlorinated diphenyl, are generally desirable ingredients of the vitreous design films in order to provide the desired film flexibility. However, dependent upon the method of application and other factors, the plasticizers can sometimes be omitted from the resinous films.

The vitreous design 5 is usually a composite or compound layer formed by imprinting a plurality of successive ceramic color compositions in liquid form over the clear layer 4 by screen printing or other suitable printing techniques. The printing composition consists of a pigmented vitrifiable material or flux and an organic liquid vehicle or binder in which the pigmented flux is dispersed or suspended. The pigmented flux materials are supplied by ceramic color manufacturers and are added to the vehicle or binder by the manufacturer of the decalcomania. The vehicle or binder may be any of the lacquers described above in connection with the clear resinous layer 4. The proportion of pigmented flux to vehicle or binder may be regulated in accordance with the requirements of the particular decalcomania. In general, the flux to binder ratio on a weight basis may range from about 2:1 to as high as about 5:1.

In the commercial development of the heat release vitreous decalcomania for use in machine application to ceramic or glassware, the use of polyethylene glycol heat release coatings has been found to give the most acceptable commercial results in spite of intensive efforts to find other acceptable heat release materials. However, dependent upon the ceramic colors used, the nature of the design, the firing cycle, and possibly other factors, it has been recognized that a problem may occur from time to time with distortion of the design during firing. I have determined that the apparent cause of this difficulty is the fact that upon heat release of the backing sheet from the design, a certain amount of the polyethylene glycol heat release material adheres to the exposed outer surface of the applied design. During subsequent firing of the ware at an elevated temperature, the residual polyethylene glycol material melts and "balls up" or draws together in small droplets or globules, and apparently during vaporization these droplets have an adverse physical effect on the design layer resulting in a characteristic distortion as evidenced by a mottled or spotted appearance of the final vitrified design.

The mottled or spotted appearance is generally more noticeable in the case of multiple overlay portions of the design as compared with a single layer. In other words, where all or a portion of the design comprises superimposed color layers, the distortion effect is more likely to occur. The condition also appears to occur most often when a relatively short time firing cycle is employed. Although the somewhat mottled or spotted appearance may be so slight as to be insignificant in many cases, nevertheless, for certain types of ware and for certain designs such defects may be objectionable and it is desirable to provide some means for avoiding this difficulty.

I have discovered that the above-described design distortion and disfigurement problem can be eliminated by washing the outer surface of the applied design on the

ware with water or other aqueous liquid after the application step and before the firing step. The normally solid polyethylene glycol materials have the somewhat unique property of being water soluble as well as being meltable wax-like materials which are also soluble in certain organic solvents.

In accordance with the usual method of application, the ware will have a temperature of from about 150° F. to about 325° F., usually from about 200° F. to about 250° F., at the time the heat release decalcomania is applied. Following the removal of the backing sheet, the water or other aqueous wash liquid is applied to the outer surface of the applied design and to the adjacent areas of the ware, preferably by means of suitable spray devices. The wash liquid is preferably at an elevated temperature, i.e. substantially above room temperature, to obtain maximum removal of the polyethylene glycol material from the design surface in the shortest time. For example, a wash liquid temperature of from about 150° F. to about 200° F. is preferred, and in order to avoid thermal shock to the ware, it is desirable to have the temperature of the aqueous wash liquid generally the same as the temperature of the ware.

For best results the wash water is preferably distilled or deionized water in order to prevent calcium deposits and staining of the design by metal ions. A small amount of a surfactant or wetting agent may advantageously be included in the wash water to promote wetting of the surface of the design and the ware and to facilitate solution of the polyethylene glycol material in the wash liquid.

In an automatic continuous line, the decorated ware after being sprayed or rinsed with wash liquid to remove residual polyethylene glycol material from the outer surface of the applied design is conveyed to the firing oven or lehr. During the time of travel to the lehr, the excess wash liquid drains off and evaporates before the ware enters the lehr. However, no harm is done even if some liquid water remains on the ware as it enters the lehr since it will be volatilized almost immediately.

FIG. 2 is a schematic illustration, in plan view, of a typical decorating sequence for glassware, such as tumblers or bottles, embodying the present invention.

The glass articles, indicated at 10, are fed from a loading table 11 by a conveyor belt 12 through a preheat tunnel 13 in which the surface of the ware is raised to a suitable temperature, as heretofore specified. The preheated articles 10 are then discharged one-by-one from the belt 12 to a rotary index table 14 by means of a feed worm and gate 16. The index table 14 rotates stepwise, in a clockwise direction as viewed in FIG. 2, and brings each glass article 10 successively into register with a rotary vacuum pick-up head 17 of conventional design and with a reciprocal pressure platen or head 18. Heat release decalcomanias are supplied automatically from a hopper 19 to the pick-up head 17 and are positioned on the article 10 by the latter. The table 14 then advances the article to the next stage where the platen 18 presses the decalcomania firmly against the surface of the article. As the table 14 continues to rotate, the released paper backing is displaced from the article 10 by means of an air jet from a pipe 21.

A second rotary index table 22 is positioned adjacent the table 14 and is equipped with a pick-up head 23, a pressure head 24, a decalcomania supply hopper 26, and an air jet pipe 27 (similar to the corresponding devices 17, 18, 19, and 21) for applying a second design to the articles when such is desired.

A discharge turntable 28 cooperates with the index table 22 and feeds the decorated articles onto the belt 12. The articles are then conveyed past one or more spray devices 29 whereby warm or hot water is sprayed against the decorated areas of the articles for dissolving and washing any adherent traces of polyethylene glycol from the exposed surface of the design. The articles then pass

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on the belt 12 into the usual annealing Lehr 31 where the design is fused into the surface of the ware.

Although the invention has been illustrated in FIG. 2 in conjunction with an application machine of the type known as Pony Express manufactured by New Jersey Machine Corp. of Hoboken, N.J., it is to be understood that the water wash principle can be used with any type of automatic line. For example, the machine illustrated in U.S. Patent No. 3,031,370 may be used.

I claim:

1. In the method of decorating an article of glassware, chinaware, or the like by means of a heat release vitreous decalcomania having a backing, a normally solid polyethylene glycol heat release coating on said backing, and a vitreous design disposed over said coating and having an exposed thermoplastic surface, which method includes the steps of (a) preheating the article, (b) pressing the vitreous design side of the decalcomania against the surface of the preheated article to temporarily adhere the design to the article and at the same time to melt the coating and release the backing, (c) removing the backing, and (d) subsequently firing the ware at an elevated temperature to permanently fuse the design thereto; the improvement which comprises the step of washing the outer surface of the temporarily adhered design, between steps (c) and (d), with an aqueous wash liquid to remove residual polyethylene glycol from said design, whereby to avoid possible distortion and disfiguration of the design during step (d).

2. The method of claim 1 further characterized in that said wash liquid is at an elevated temperature substantially above room temperature.

3. The method of claim 1 further characterized in that said wash liquid has a temperature generally the same as the temperature of the ware.

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4. The method of claim 1 further characterized in that said wash liquid comprises water at a temperature of from about 150° F. to about 200° F.

5. The method of claim 1 further characterized in that said wash liquid comprises distilled or deionized water.

6. The method of claim 1 further characterized in that said wash liquid includes a wetting agent.

7. The method of claim 1 further characterized in that said wash liquid is applied by spraying the same against the ware.

8. The method of claim 1 further characterized in that said vitreous design comprises a vitrifiable ceramic color in a resinous film.

9. The method of claim 8 further characterized in that said resinous film is selected from the group consisting of ethyl cellulose and acrylic resin films.

10. The method of claim 8 further characterized in that said article comprises glassware, said resinous film comprises a methacrylate polymer, and said wash liquid comprises water at an elevated temperature substantially above room temperature.

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EARL M. BERGERT, *Primary Examiner.*

G. W. MOXON II, *Assistant Examiner.*

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