This invention relates to multi-color decoration of vitreous objects such as glass, china, porcelain, enameware, etc. Hitherto great difficulty has been encountered in obtaining satisfactory results in the application of multi-color designs to vitreous objects such as those specified above. In the first place, it is necessary that ceramic coloring material be used to obtain fusion thereof with the object to be decorated and in the fusing of such coloring material there is a very objectionable tendency for the coloring material to be opaque and inaccurately deposited, and for the colors to blend improperly, thereby losing much of the detail and beauty of the design which would remain as desired where the printing is done in ordinary ink or dye colors upon non-vitreous substances, such as paper.

Considerable difficulty has been encountered in obtaining satisfactory multi-color effects on vitreous objects because during the fusing operation the sizing material or adhesive with which the ceramic coloring material is bonded to either the vitreous object itself or a decalcomania, which is most frequently used in processes of this sort, is converted into gas and in escaping causes blistering of the colored surface. While this difficulty is encountered even in single color application, the overlapping colors formed in multi-color printing constitute a blanket so thick where the colors overlap that escape of the gases formed is seriously impaired and blistering over these portions is the cause of a great deal of spoilage.

The invention set forth herein not only utilizes the spreading of the ceramic coloring material during fusing to enhance the beauty and distinctness of the applied decoration, but permits the use of from one-half to one-third the number of different colors hitherto necessary to obtain substantially the same contrasting effects. Furthermore, blistering is substantially eliminated by reason of the fact that the coloring material as applied by my improved process does not form a solid blanket over the design of the decalcomania or the design on the object, regardless of the number of different colors used, and for that reason passages are provided through which the gas formed during the fusing operation may escape without causing eruption of the applied color.

The above outlined difficulties are eliminated and the desirable results set forth herein obtained through the application of the ceramic coloring material, either to the decalcomania from which the decoration is to be transferred to the vitreous object, or to the treated vitreous object itself, in the form of a multiplicity of spaced dots or lines which have interstices between them through which gas may escape during fusing of the coloring material. While the color might conceivably be so applied by hand, suitable gradation of color intensity cannot be obtained in this manner, and I have found that color application by means of photo-mechanically produced half-tone process engraving plates is productive of remarkably effective results. Where direct application is made to the vitreous object itself, the object is first coated over that portion to which the decorative design is to be applied with a suitable bond to receive the ceramic coloring material. Half-tone process color plates embodying different color phases of the design are photo-mechanically prepared by the use of special or line screens and the desired coloring materials applied successively by the plates to the coated portion of the object. By reason of the fact that the use of half-tone plates for color application obtains a wide range of color gradation, as to both tone and intensity, a few colors so applied constitute in effect a substitute for a greater number of colors applied in any other way. The ceramic coloring may be applied by any of the various known processes, such as stone, letter press, lithography, etc.

Whether dots or lines are used in making the half-tone plates, the screens through which the plates are photographically made should be turned at various specific angles for each color and, since the screens used for each color preferably have the same number of lines, the resultant dots formed upon the plate for each color will have a specific relative position with reference to the dots by which another color is applied. For the same reason certain of the dots overlap one another and the visual effect is a substantial reproduction of the master design and color.

The gases pass off between the dots, thereby substantially eliminating blisters which occur in ordinary color printing by one process or another where the color coats overlap.

Several color applications may be made by means of such half-tone plates and the breathing spaces will not thereby be eliminated. Furthermore, by reason of the fact that the screening process used in forming the plates obtains such a wide gradation of intensity for each single color, a few color applications so graded in intensity will obtain results comparable, and superior because of the mode of application, to results obtained in other processes by the use of numerous
color applications. For this reason the blanket formed by such overlapping color dots as may develop during the process of applying several colors will not be so thick as those resulting from ordinary procedures, and escape of gas is thereby further facilitated, with consequent decrease of blistering and spoilage.

While the invention is described above in connection with the direct application by printing to the vitreous object itself, it is equally applicable to all known procedures for the application of ceramic coloring material to vitreous objects. For instance, the same advantages are derived in the same way and the same difficulties overcome through use of my invention where the decorative design is printed directly on the vitreous object in some suitable sizing or bond to which ceramic coloring material is later applied by means of dusting.

The invention is likewise applicable to the production of decalcomanias or transfer sheets bearing a design to be later transferred to the vitreous object and fused thereon. When decalcomanias of any kind are applied to the vitreous object they must be attached with some bonding material such as decalcolastic, gum arabic, etc. This means the adhesive is between the decalcomania and the object on which the decoration is to be fused. In order for the fusing to take place, the adhesive must pass off as a gas and this is particularly well and uniformly accomplished when my invention is used. Even if there are a number of colors, and the dots do overlap, they form scales which permit the gas to come out between them and then, when the fusing takes place after the gas escapes, the colors bind together.

Where such transfer sheets are used the decorative design is applied in the usual way to the transfer film by the use of process half-tone plates, or the design is imprinted by the use of such plates upon a sizing with which the transfer sheet is sized and the ceramic coloring material later applied to the design so imprinted by means of dusting.

Only the basic steps involved in the procedures have been described above, and it is to be understood that a flux of suitable composition can be used over the whole design including the dots between the colors or entirely over any portion of the design in order to control the fusion point of any set of colors or oxides, whether they would fire without this coating at either a higher or lower temperature. This is not to be confused with applying flux to underglaze decalcomanias for the purpose of mechanically holding the design during a hardening-on (or preheating, to destroy varnish gases) and for future handling during and after glazing operations. Hitherto the flux used to control the fusion point has been mixed with the coloring matter and other more or less inert materials.

However, it is important in the preparation of ceramic colors for ceramic decalcomanias, or for direct glazing ceramic colors on objects, that fluxes be incorporated in the color which have fusing temperatures compatible with the fusing temperatures of the particular vitreous objects to which the color design is to be applied. The fusing temperatures of various types of glassware, porcelain, pottery, etc., differ considerably, and a flux of the same fusing temperature is not suitable for use with all kinds and types of vitreous ware. For that reason I print a flux over the ceramic coloring material or oxides to be applied and completely over the dots or spaces between the particles of ceramic coloring or oxides to be applied to the transfer sheet or object by the procedure outlined above.

By this method it is possible to stock and use identical ceramic color decalsamian sheets. Then when a particular order is placed, a flux which is suitable for the specific work to be decorated is run over top of all the design, including the spaces between the spots of ceramic color. This substantially decreases the number of colors, or the number of decalcomanias sheets, which need be kept in stock and insures satisfaction to the customer because of the fact that the final coating of flux is particularly suited to his needs. This procedure also gives a desirable added luster and protection, as well as additional bond to the applied decoration or design.

What I claim is:

1. That method of decorating a vitreous object with a multi-color design by ceramic color deposits which comprises the steps of coating that portion of the surface to be decorated with a suitable bond, successively applying separately different colored oxides or oxides of ceramic coloring material to the transfer sheet or object by the procedure outlined above. Thus a multiplicity of spaced colored lines or dots, all those of each color being specifically angled with respect to all of each other color and forming interstices between color deposits, and fusing the color to the object at a temperature sufficient to fuse the bonding material and expel the same through the said interstices.

2. That method of decorating a vitreous object with a multi-color design by ceramic color deposits which comprises the steps of coating that portion of the surface to be decorated with a suitable bond, imprinted thereon a multi-color design in the form of a multiplicity of spaced lines or dots, all those of each color being specifically angled with respect to all of each other color and forming interstices between color deposits, and fusing the color to the object at a temperature sufficient to fuse the bonding material and expel the same through the said interstices.

3. That method of multi-color decorating vitreous objects which comprises the steps of forming a transfer sheet by applying to the surface thereof a ceramic color bond, separately applying to such bond because of different ceramic coloring materials in the form of a multiplicity of spaced colored lines or dots, all those of each color being specifically angled with respect to all of each other color and forming interstices between color deposits, and subjecting the object so treated to a temperature sufficient to fuse the ceramic coloring materials with the object and expel the bonding material in the form of gas which passes off through the interstices between the color deposits.

4. That method of multi-color decorating vitreous objects which comprises the steps of coating a transfer sheet with suitable sizing, imprinting thereon a multi-color design in the form of a multiplicity of spaced lines or dots, all those of each color being specifically angled with respect to all for each other color and forming interstices therebetween, successively dusting different portions of the imprinted design separately with different ceramic coloring materials, transferring the coloring materials to a vitreous
object, and subjecting the latter to a temperature sufficient to fuse the ceramic coloring materials with the object and expel sizing in the form of gas which passes off through the interstices between the color deposits.

5. That method of multi-color decorating vitreous objects which comprises the steps of forming a transfer sheet by applying to the surface thereof a ceramic color bond, separately applying to such bond successive different coloring materials in the form of a multiplicity of spaced colored lines or dots, all those of each color being specifically angulated with respect to all of each other color and forming interstices between color deposits, coating the coloring materials and the interstices therebetween with a suitable flux, transferring the coloring materials and flux to a vitreous object, and subjecting the object so treated to a temperature sufficient to fuse the ceramic coloring materials with the object.

6. A vitreous object having fused to the surface thereof ceramic coloring materials in the form of a multiplicity of lines or dots, those for each color being all specifically angulated with respect to those for each other color whereby interstices between color deposits are formed.

7. A transfer sheet having imprinted thereon in ceramic coloring materials a multi-color design in the form of a multiplicity of lines or dots, those for each color being all specifically angulated with respect to those for each other color whereby interstices between color deposits are formed.

8. A transfer sheet having imprinted thereon in ceramic coloring materials a multi-color design in the form of a multiplicity of lines or dots, those for each color being all specifically angulated with respect to those for each other color whereby interstices between color deposits are formed, said color materials and the interstices being coated with a suitable flux.

9. That step in the multi-color decoration of vitreous objects which consists in forming a transfer sheet by applying to the surface thereof a ceramic color bond, and separately applying to such bond successive different ceramic coloring materials in the form of a multiplicity of spaced colored lines or dots, all those of each color being specifically angulated with respect to all of each other color and forming interstices between color deposits.

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