Nov. 23, 1965 P. P. DUSINA, JR., ET AL 3,219,506

METHOD OF MAKING COLOR INLAYS

Filed Nov. 1, 1960 2 Sheets-Sheet 1

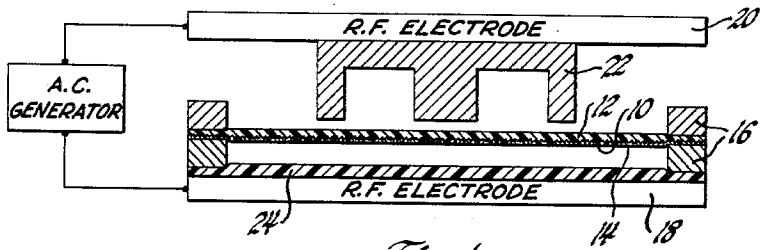


Fig. 1

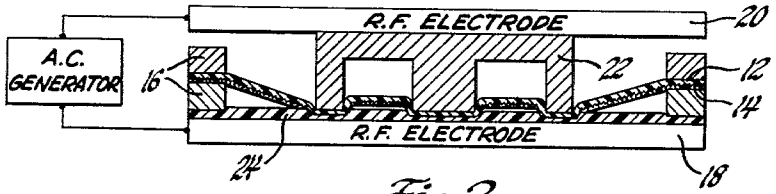


Fig. 2

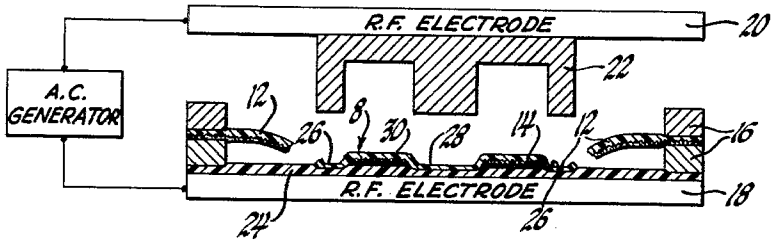


Fig. 3

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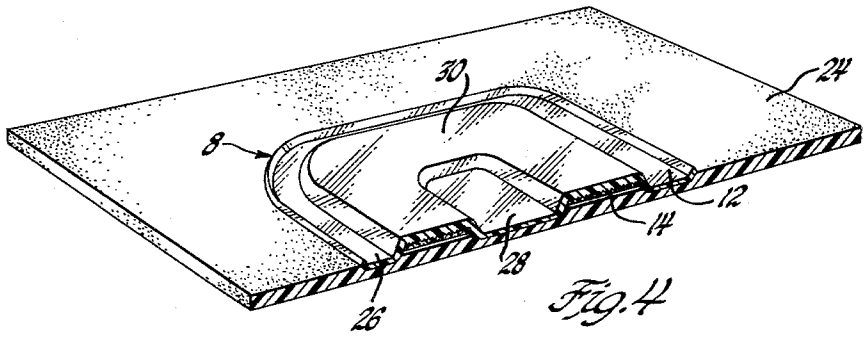


Fig. 4

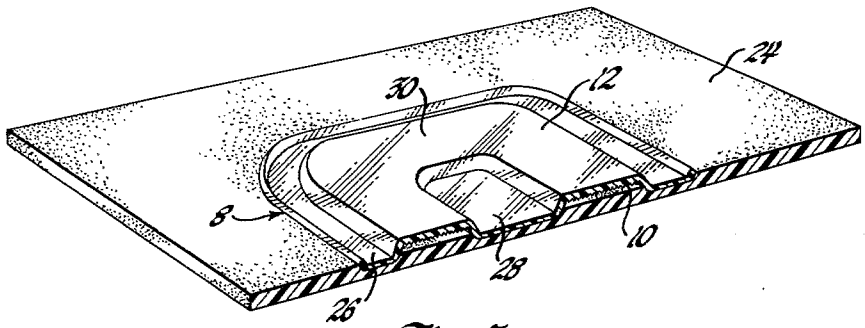


Fig. 5

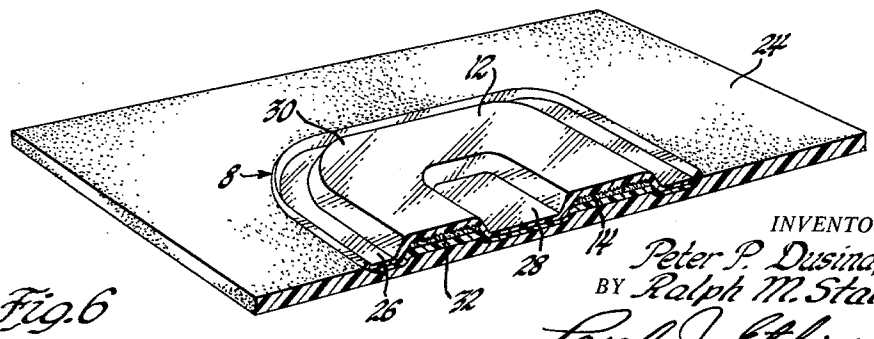


Fig. 6

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METHOD OF MAKING COLOR INLAYS

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This invention relates to dielectric embossing and more particularly to a method of producing multiple color inlays by dielectric embossing.

The Patent 2,991,216 to M. C. Hsu and R. M. Stallard, and assigned to the assignee of this invention, discloses a method and apparatus for dielectrically embossing a finite portion of thermoplastic sheet material to another sheet of thermoplastic material and, in the same operation, dielectrically cutting the finite portion from sheet stock thereby producing an article of sheet material with a decorative layer of other material secured thereto. That invention is widely used commercially to produce automobile door trim panels having decorative designs made of different colored materials. However, an inherent limitation of that process and other processes in the art is that prior to the present invention they were not adapted to making very small and intricate designs of contrasting colors, and also that a design of more than two colors would require more than one embossing operation.

The object of this invention is to provide a method of making multiple color inlays which may be of small and intricate design and which may utilize two or more colors or hues while requiring only a single embossing operation.

The invention is carried out by rendering a sheet of light transmitting material translucent or opaque on one surface thereof, dielectrically embossing that surface onto a sheet of underlying material so that the opaque or translucent surface is caused to increase its degree of light transmission in the embossed portions to provide a contrast with unembossed portions.

The above and other advantages of the invention will be made more apparent from the following description taken in conjunction with the accompanying drawings wherein like numerals refer to like parts and wherein:

FIGURES 1, 2 and 3 are cross-sectional views showing the apparatus and method for carrying out the invention; and

FIGURES 4, 5 and 6 are sectioned, perspective views of articles formed by three different embodiments of the present invention.

The first step in the method of forming multiple color inlays 8, according to one embodiment of the invention, is treating one surface 10 of a clear thermoplastic sheet 12, such as a clear vinyl, so that the sheet is made translucent or acquires a foggy or milky appearance. This may be accomplished by mechanically roughening or etching the surface of the sheet by sandpaper or a wire brush, for example, or alternatively the surface may be etched by chemical means. Secondly, the sheet is coated with a pigment 14 on its etched surface 10 so that it is rendered highly colored or opaque. One satisfactory means of coating the sheet material has been found to be applying a film of colored vinyl thereto. Thus the etching of the sheet not only serves to change its appearance but also forms a base for the application of a coating. Thirdly, the treated sheet of material is placed in a supporting frame 16 of the type illustrated in FIGURE 1 so that the material is held taut and is held spaced from a dielectric embossing electrode 18.

The operation of the embossing apparatus is fully described in S.N. 648,654, referred to above; but, briefly, as can be seen from FIGURES 1, 2 and 3, an upper electrode 20 having a die 22 conforming in shape to the pattern desired to be formed in the material is moved down against the taut sheet 12 and moves the finite portion of the sheet within the confines of the die toward the lower electrode and presses the sheet material 12 against a layer of thermoplastic base material 24 which is supported on the lower electrode 18. Radio frequency current is passed through the thermoplastic sheets 12 and 24 from one electrode to the other to cause internal heating of the said sheets. This heating is sufficient to cause fusion of one sheet of material to the other, and, at the periphery of the die 22 to melt the tensioned sheet of material 12 sufficiently to cause it to separate from the embossed portion 8 as indicated in FIGURE 3. During this heating process a critical step of the invention occurs. The heat generated within the thermoplastic materials, combined with the pressure of the die 22, causes the material to flow from the areas 26 and 28 directly beneath the die and to carry the colored vinyl 14 or other pigment along with it. In other words, the pigment 14 is squeezed out from underneath the die 22. In addition, due to the melting and subsequent cooling of the materials, the etched surface 10 attains a smooth finish, the result being that the color of the lower layer of base material 24 clearly shows through the upper layer of plastic in the embossed portions 26 and 28 while the unembossed portions 30 retain the pigment 14 so that, not only are raised designs 30 produced, but contrasting colors are present as well. It should be noted that the portions of the material in contact with the die 22 are cooled by conduction of heat to the die so that the lower surface of the sheet 12 may reach the melting point while the upper surface does not. It is this unique characteristic of dielectric embossing which makes this process possible. An illustration of a finished article formed by the above-described process is shown in FIGURE 4.

A second embodiment of the invention comprises roughening or etching a surface 10 of a clear thermoplastic material 12 to render it translucent and then to emboss this material onto the base material 24. This process is exactly the same as that described above except that the pigment has not been added to the upper sheet of plastic 12. The contrast between portions of the resulting article, shown in FIGURE 5, results from the fact that the raised portions 30 of the plastic are translucent or milky while the depressed portions 26 and 28 have become clear due to the melting of the etched surface 10 as described above.

A third embodiment of the invention used to produce the article of FIGURE 6 comprises etching the lower surface 10 of the plastic sheet 12, coating the etched surface with a pigment 14, placing the sheet 12 in a frame 16 between the electrodes, placing a base material 24 on one electrode 18, placing a third sheet of material 32 between the other two sheets 12 and 24 in alignment with and shaped similar to the die 22 and embossing the three sheets of material together. As described for the first embodiment of the invention, the pigment on the upper sheet 12 is squeezed from under the embossing die 22 and will then reveal the color of the third layer of material 32 which is sandwiched between the other two layers. With this method one obtains not only a contrast between the raised and embossed or depressed portions of the inlay 8, but also between the inlay 8 and the surrounding base material 24 which may be of a third color. One very effective variation of this embodiment omits the pigment. For example, the use of a clear uncoated vinyl with its lower surface 10 etched for the upper layer 12, a metalized Mylar sheet for the inner layer 32 and any other contrasting color for the lower or base layer 24. The raised portions 30 of the article will have the appearance of brushed metal and the depressed portions 26 and 28 will look like highly polished metal which

is contrasted with the base material. If preferred, the metalized Mylar layer may extend only within the inner borders of the peripheral depressed portion of the design so that only those depressed portions **28** at the center of the design are given the appearance of polished metal while the peripheral depression **26** assumes the same color as the base material **24**.

Another modification of the process comprises placing a separate film of pigmented material (not shown) between an upper transparent or translucent plastic sheet and the base material and embossing the sheets as previously described. This film substitutes for the coating of pigmented material on the upper sheet. The film of pigmented material will, as before, be squeezed from beneath the die so that the base material shows through the depressed portions. With this latter process, the etching of the plastic material **12** is unnecessary although it may be used to produce the desired appearance. In the previous process described the purpose of the etching was to form a base for the coating to be applied thereto. In commercial use it is preferable to form the coating of pigment on the thermoplastic material at the time the material is manufactured so that the etching and coating steps of the process would be eliminated as far as the embossing operation is concerned.

Other very effective variations of the processes described above will be apparent to those skilled in the art and may be practiced without departing from the spirit of the invention. For example, one may etch both sides of the upper layer of thermoplastic so that the resulting article will have the textured appearance of suede, or if desired, the upper layer may be a tinted rather than a clear material.

It is clear that this invention provides a method of dielectrically embossing multiple color inlays which may be of small and intricate design and which may be made up of two or more colors or hues while requiring only a single embossing operation.

The embodiments of the invention described herein are for illustrative purposes only and are not intended to limit the scope of the invention which is defined by the following claims.

What is claimed is:

1. A method of making a multiple color inlay on a dielectrically embossable thermoplastic base material comprising the steps of coating one surface of a dielectrically embossable colorless plastic sheet with a film of pigmented dielectrically embossable thermoplastic and dielectrically heating portions of said one surface and said base material under sufficient pressure whereby the coating is caused to flow from the portions to render said portions colorless thereby revealing the color of base material.

2. A method of making a multiple color inlay on a dielectrically embossable thermoplastic base material comprising the steps of roughening one surface of a transparent and colorless dielectrically embossable plastic sheet, coating said surface with a pigmented material, placing the coated surface in contact with the base material, and dielectrically heating portions of said one surface and said base material under sufficient pressure whereby the coating is caused to flow from the portions to render said portions transparent and colorless thereby revealing the color of the base material.

3. A method of making a multiple color inlay on a dielectrically embossable thermoplastic base material of one color comprising the steps of placing an insert sheet of another color material on said base material, coating one surface of a light-transmitting dielectrically embossable thermoplastic sheet with a colored dielectrically embossable thermoplastic, placing said latter sheet on said insert sheet with said coated surface contacting said insert sheet, and dielectrically heating portions of said materials under sufficient pressure whereby the coating is caused to flow from the portions to render said portions colorless thereby revealing the color of the insert layer.

4. A method of making a multiple color inlay on a dielectrically embossable thermoplastic base material comprising the steps of treating one surface of a transparent dielectrically embossable thermoplastic sheet so as to make it opaque, placing said surface in contact with the surface of the base material, applying high frequency electrical energy to portions of the thermoplastic sheet and base material, and simultaneously applying pressure at said portions whereby the latter becomes transparent to reveal the color of the base material and the thermoplastic sheet is bonded to the base material.

5. A method of making a multiple color inlay on a dielectrically embossable thermoplastic base material comprising the steps of treating one surface of a translucent dielectrically embossable thermoplastic sheet so as to make it opaque, placing said surface in contact with the surface of the base material, applying high frequency electrical energy to portions of the thermoplastic sheet and base material, and simultaneously applying pressure at said portions whereby the latter becomes transparent to reveal the color of the base material.

6. A method of making a multiple color inlay on a dielectrically embossable thermoplastic base material comprising the steps of roughening one surface of a colorless and transparent dielectrically embossable thermoplastic sheet so as to make it translucent, placing said surface in contact with the surface of the base material, applying high frequency electrical energy to portions of the thermoplastic sheet and base material and simultaneously applying pressure at said portions whereby the latter becomes transparent to reveal the color of the base material.

7. A method of making a multiple color inlay on a dielectrically embossable thermoplastic base material comprising the steps of treating one surface of a transparent dielectrically embossable thermoplastic sheet so as to make it translucent, placing said surface in contact with the surface of the base material, applying high frequency electrical energy to portions of the thermoplastic sheet and base material to cause melting at the contacting surfaces, and simultaneously applying pressure at said portions whereby the latter becomes transparent to reveal the color of the base material.

8. A method of making a multiple color inlay on a colored dielectrically embossable thermoplastic base material comprising the steps of coating one surface of a transparent and colorless dielectrically embossable thermoplastic sheet with a film of pigmented dielectrically embossable thermoplastic, placing said coating in contact with the surface of the base material, applying high frequency electrical energy to portions of the thermoplastic sheet and base material to cause melting at the contacting surfaces, and simultaneously applying pressure at said portions so that the coating is caused to flow laterally from said portions to render the latter transparent to reveal the color of the base material.

9. A method of making a multiple color inlay on a dielectrically embossable thermoplastic base material comprising the steps of placing said base material in a dielectric heating press having a pair of spaced electrodes, treating one surface of a transparent dielectrically embossable thermoplastic sheet so as to render it opaque, placing said thermoplastic sheet in said press with said treated surface facing said base material, closing the press to compress portions of the base material and sheet between the electrodes, and applying high frequency electrical energy between the electrodes so as to simultaneously bond said sheet to said base material and cause said treated surface at said compressed portions to become transparent to thereby reveal the color of the base material.

10. A method of making a multiple color inlay on a

dielectrically embossable thermoplastic base material comprising the steps of treating one surface of a transparent and colorless dielectrically embossable thermoplastic sheet so as to make it translucent, coating the other surface of said sheet with a film of pigmented material, placing the coated surface towards the base material, and dielectrically heating portions of said sheet and base material under sufficient pressure whereby the coating is caused to flow from the portions to render said portions translucent and colorless so as to reveal the color of the base material.

References Cited by the Examiner

UNITED STATES PATENTS

2,648,924	8/1953	Brewster	154—535
2,697,893	12/1954	Schaum	41—24
2,729,009	1/1956	Markus	154—106 X
2,739,909	3/1956	Rosenthal.	
2,749,640	6/1956	Scott	156—251 XR
3,047,443	7/1962	Anderson	41—24 XR

FOREIGN PATENTS

706,109	3/1954	Great Britain.

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