United States Patent

Rosenberg

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[54] METHOD OF MAKING DECORATIVE ARTICLES FROM PLASTISOL

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[22] Filed: **July 23, 1969**

[21] Appl. No.: **865,542**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 812,795, April 2, 1969, abandoned.

[52] **U.S. Cl.**.....**264/73,** 117/39, 264/216, 264/236, 264/298, 264/331

[51] **Int. Cl.**.....**B29d 7/02,** B29c 25/00, B29c 5/00

[58] **Field of Search**.....264/73, 74, 75, 331, 298, 180, 264/216, 236, 212, 165; 117/39

[56] **References Cited**

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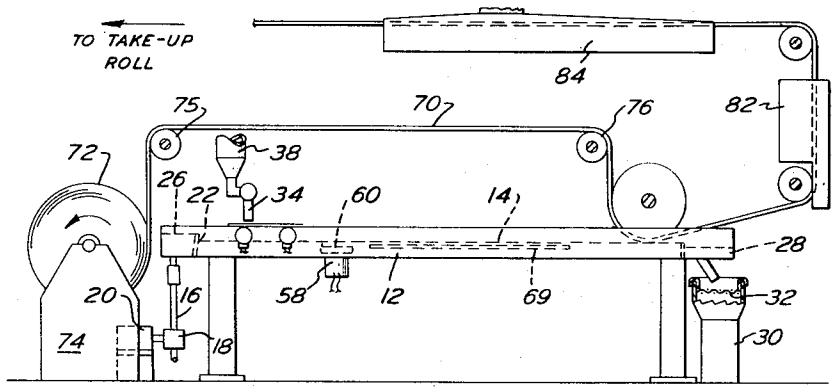
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[57] **ABSTRACT**

A method of making decorative articles from plastisol is disclosed. In one of its forms, the method is performed by placing bodies of liquid or semi-liquid plastisol of different color on the surface of a pool of liquid material immiscible with the plastisol and having a density in excess of the density of the plastisol. The bodies of plastisol are intermingled as they float on the pool to form a mass having a variegated marblelike appearance. The mass may then be gelled, or alternatively, fused, and then removed from the pool. One aspect of the disclosed method is a step of compressing ungelled plastisol prior to or during gelling to preclude the presence of bubbles in the finished article.

7 Claims, 7 Drawing Figures



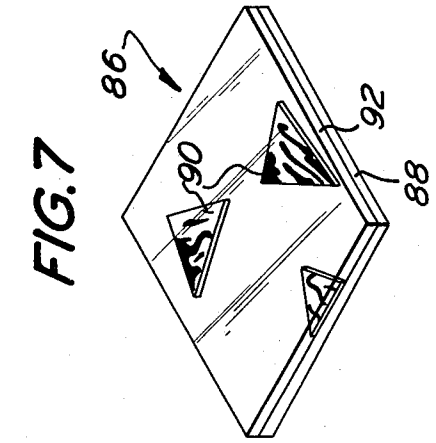


FIG. 7

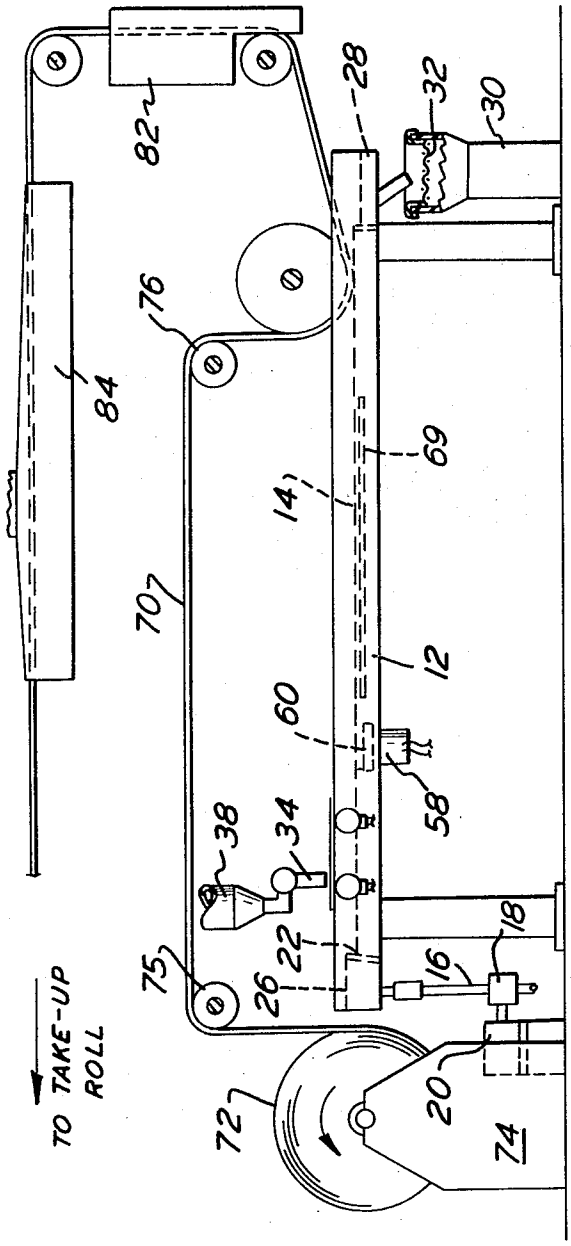


FIG. 1

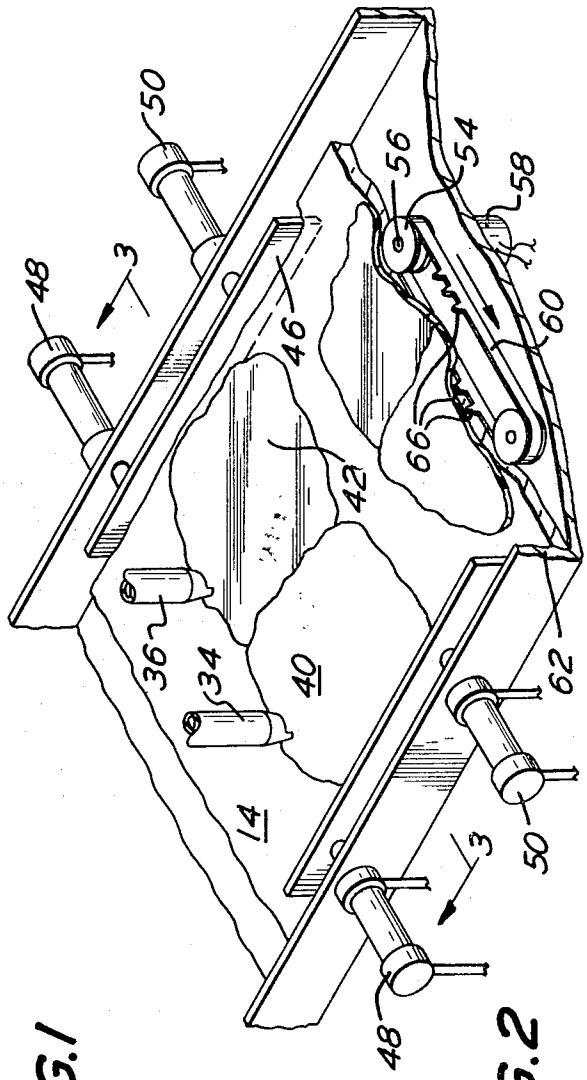


FIG. 2

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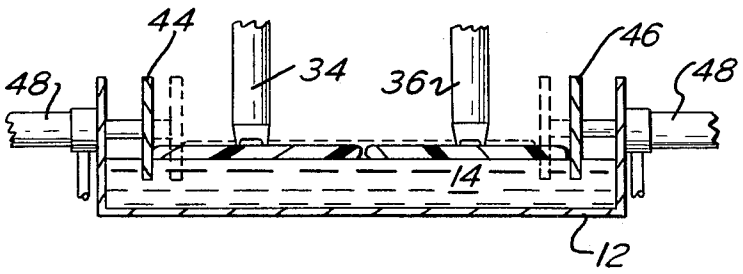


FIG.3

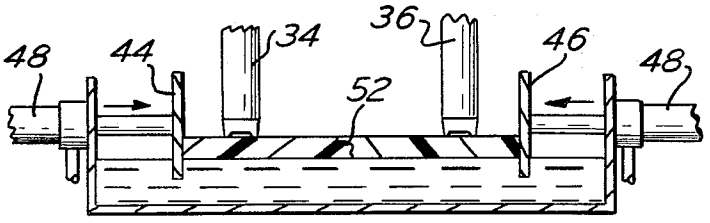


FIG.4

FIG.5

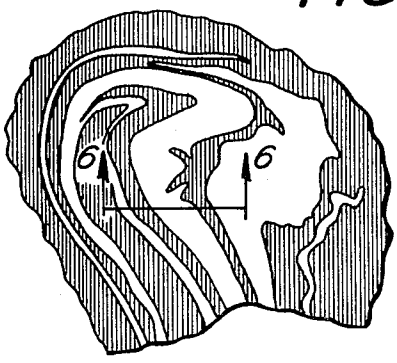


FIG.6



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METHOD OF MAKING DECORATIVE ARTICLES FROM PLASTISOL

This application is a continuation-in-part of application Ser. No. 812,795, filed Apr. 2, 1969, now abandoned.

This invention relates to a method of making decorative articles, and more particularly, to a method of making a flat article of variegated or marble-like appearance from material such as vinyl plastisol.

The term plastisol is used to describe a suspension of finely divided vinyl chloride polymer or copolymer in a liquid plasticizer which has little or no tendency to dissolve the resin at room temperature, but becomes a solvent for the resin when heated. Typically, plastisols take the form of viscous liquids, semi-liquids or pastes at room temperature. Fillers, colorants or stabilizers may be added, but volatile solvents and diluents are maintained at less than ten percent.

Upon heating, the plastisols form an initial gelatinous structure, and ultimately a solid, inert, more or less flexible mass.

Plastisols have found increasingly wide commercial acceptance and usage. For example, products may be made from plastisols by spreading the material on substrates, dipping forms to be coated into the plastisol, or by casting in stationary or rotary molds. In one common application, plastisols have been used to produce hollow articles by well-known "slush casting" techniques.

The present invention is directed to a method of making from plastisol a decorative article, particularly suited for incorporation into flooring or the like. Decorative polymeric flooring materials, such as vinyls, are not per se new. Typically, such materials are formed into floor materials by conventional techniques of casting, or extrusion or calendering. With the present method, patterns not obtainable by any other known method may be obtained. Moreover, such patterns may be obtained on a repetitive basis and at production rates making commercial usage feasible. The present method overcomes a well-recognized and longstanding problem in the use of plastisols, namely the problem of unwanted bubbles or gaseous inclusions.

In view of the foregoing, it is an object of this invention to provide a novel method of making decorative articles from plastisol.

It is another object to provide a method wherein variegated polymeric articles having predictable decorative patterns may be produced from plastisol.

It is yet another object to provide a method of making decorative articles from plastisol, especially suited for use in the manufacturing of flooring materials.

It is yet another object of this invention to provide a method of making decorative articles from plastisol, the articles being of uniform composition, without bubbles or unwanted gaseous inclusions.

It is a still further object of this invention to provide a method of making flooring materials, using plastisols.

Other objects will appear hereinafter.

Briefly stated, in one of its variations, the present method involves placing a body of plastisol on a pool of liquid material having a density in excess of the density of the plastisol and with which the plastisol is immiscible. An area of the pool is maintained at a temperature in excess of the temperature at which the plastisol gels. The plastisol is left on the surface of the pool for a time sufficiently long for gelation to occur. The gelled article is then removed from the supporting liquid, and subjected to further heating until solidified. Separate bodies of plastisol of different color may be placed on the surface of the pool, and intermingled to produce a variegated, marble-like effect. Such intermingling of the different colored plastisols is made to occur prior to gelation.

In another variation of the method, the plastisol is brought to its fused, solidified state by the heat of the supporting liquid.

In other variations of the method, heat sources other than the supporting liquid are used to gell or fuse the plastisol while it is supported on the supporting liquid.

The problem of bubbling, it has been found, may be overcome by compressing the plastisol prior to or during gelation.

The above-described process may be performed as a batch operation, but for production purposes, a continuous operation is preferred. In such case, the plastisol supporting liquid is a continuously moving pool of recycled liquid (is a continuously moving pool of recycled liquid.) The plastisol body moves with the supporting liquid as the bubble-preventing and intermingling steps are performed. The gelled plastisol body can then be removed from the supporting liquid by bringing it into contact with a continuously moving web of flexible substrate material.

I am aware that paints, inks, and the like have in the past been applied to paper or cloth substrates by first floating them on supporting liquids. Such techniques have not heretofore been used in polymeric flooring or the like.

For the purpose of illustrating an apparatus capable of performing the method of the present invention, there is shown in the drawing a form which is presently preferred; it being understood that the invention is not limited to the precise arrangements and instrumentalities shown.

FIG. 1 is a side elevation view of an apparatus for performing the present inventive method on a continuous basis.

FIG. 2 is a detail view of a portion of the apparatus in FIG. 1.

FIG. 3 is a cross-sectional view taken along the line 3—3 in FIG. 2.

FIG. 4 is a view similar to FIG. 3, showing the apparatus in a different operative position.

FIG. 5 illustrates one form of variegated article obtainable with the present method.

Practice of the present method requires the provision of a pool of supporting liquid. Such liquid, of course, must have a density in excess of the density of the plastisol, and be immiscile therewith. Liquid metals, such as low melting alloys having melting points below the gel temperature of the plastisol, and preferably in the range of 115° to 130° F., may be used. One suitable low melting alloy is the alloy sold under the trademark "CERRO ALLOY NO. 97" by Belmont Smelting & Refining Co. In addition to the above, glycerin has been found suitable for use as the supporting liquid. Also, mercury may be used, although it is not preferred due to its obvious toxicity hazard.

In one form of the method, an area of the supporting liquid is maintained at a temperature in excess of the gel temperature of the plastisol. Such gel temperature depends on the formulation of the plastisol. For a discussion of the effect of formulation upon gel temperature, see the book Plasticizers, published by Rohm & Haas Company, 1960. The plastisol must remain on the support liquid for a time sufficiently long for substantial gelation to occur. In other words, the plastisol must be heated to a temperature above gel temperature, and must remain at such temperature until substantial gelation occurs.

After gelation, the article maybe removed from the supporting liquid. A presently preferred technique for removing the gelled article from the supporting liquid involves bringing a substrate into surface contact with the supporting liquid and the gelled article, and then lifting the substrate. The substrate and gelled article can then be brought to the fusion temperature of the plastisol. Such heating may be accomplished in conventional ovens or through the use of radiant energy techniques, such as heat lamps or the like.

Numerous materials can be used as the substrate. For example, paper-like materials or woven textile fabrics may be used. As will be explained later, especially desirable results may be obtained by using flexible plastic polymeric substrates, such as sheet vinyl.

In a variation of the method, the temperature of the supporting liquid and time interval during which the plastisol is supported thereon are such that both gelation and fusion of the plastisol occur while it is on the support liquid. The fused plastisol is thereafter removed from the supporting liquid in the above-described manner.

In the above-mentioned forms of the method, the plastisol is heated directly by the supporting liquid. In a further variation

of the method, external heat sources, such as heat lamps may be used to bring the plastisol to the desired temperature.

A significant aspect of the present process is the manner in which bubbles or gaseous inclusions in the plastisol are eliminated. In this regard, it has been found that compression of the plastisol after it has been placed on the supporting liquid before or during gelation substantially eliminates any bubbling tendency. When placed on the supporting liquid, the plastisol tends to spread to a rest configuration, dependent upon its viscosity, its composition, and the viscosity of the supporting liquid. Typically, a body of plastisol may spread to form a film having a thickness of about 50 mils. In one form of the method the body is "stretched" beyond its rest position to substantially thin the film, and then, by applying force to its edges, "compressed" to a thickness approaching its original rest thickness, its tendency to bubble is substantially decreased. In the case of a body of plastisol having a 50 mil thickness, it was found that stretching to the point where the film had a thickness of about 20 mils, followed by compression to about 40 mils produced the desired result. It is of course difficult to quantitatively assess the results of the above-described procedure. The relative lack of bubbles in the finished articles obtained when the foregoing procedure is followed, as compared to articles in which it is not, is readily observable, however. Simple compression, without this initial stretching may also be used.

There is seen in the drawings, FIGS. 1 to 4, an apparatus for performing the present method on a continuous basis. Referring to FIG. 1, the apparatus, designated generally by the reference numeral 10, includes a flat-bottomed tray-like vessel 12 for containing the support liquid 14. The support liquid 14 is fed continuously to the vessel 12 through a conduit 16. A pump 18, having suitable characteristics, is provided to circulate the support liquid 14. A motor 20 is provided to drive the pump 18.

Spaced upstanding baffles 22, 24 extend across the vessel 12. The baffle 22, an end wall of the vessel 12, and portions of the side wall of the vessel 12 define a chamber in communication with the conduit 16. The baffle 24, an end wall of the vessel 12, and other portions of the side walls of the vessel 12 define a second chamber 28, in communication with a drain stand 30. A filter 32 may be provided across the mouth of the drain 30.

It should now be apparent that support liquid brought into the vessel through the conduit 15 flows through the baffle 22, along a major portion of the length of the vessel 12 over the baffle 24, and into the drain stand 30. From the drain stand 30, the support liquid may be recycled through the vessel 12. If the support liquid is to be liquid metal, as described above, heating apparatus, not shown, is provided to maintain the material in its liquid state throughout its circulation. The pool of support liquid 14 between the baffles 22 and 24 provides a steadily flowing but non-turbulent pool to which the plastisol may be applied.

Referring to FIG. 2, nozzles 34 and 36, whose openings are preferably about flush with the surface of the support liquid 14 in the vessel 12, provide one means for applying plastisol to the support liquid 14. Referring once again to FIG. 1, a reservoir 38 for plastisol is seen diagrammatically in fluid communication with the nozzle 34. Conventional flow regulating means, not shown, may be provided to control the flow of plastisol through the nozzles 34 and 36. As is seen in FIG. 2, plastisol emerging from the nozzles 34 and 36 spreads on the surface of the support liquid 14 to form bodies of random outline. As illustrated, the body 42 is formed of plastisol having a color different from the color of the body 40.

Referring now to FIGS. 2, 3 and 4, representative apparatus for performing the steps of stretching and compressing the plastisol bodies to prevent bubble information is shown.

Plates 44 and 46, generally parallel to the sides of the vessel 12, are provided on opposite sides of the vessel 12. Remotely operable mechanical means, such as hydraulic cylinders 48 and 50, may be provided to move the plates 44 and 46 in a direction transversely of the vessel 12.

The operation of the plates 44 and 46 and hydraulic cylinders 48 and 50 to treat the plastisol bodies 40 and 42 is as follows:

Referring to FIG. 3, the initial positions of the plates 44 and 46 is shown in dotted line. When applied to the support liquid 14, the bodies 40 and 42 spread into contact or near-contact with the plates 44 and 46. The plates 44 and 46 may then be withdrawn through the urging of the hydraulic cylinders 48 and 50 to the position shown in full line in FIG. 3. It has been found that viscosity effects, hydraulic forces caused by withdrawal of the plates 44 and 46, or a combination of both, results in the plastisol of the bodies 40 and 42 following the plates 44 and 46 as they move. The result is a stretching of the bodies 40 and 42, with a resultant thinning of the plastisol film. Next, the hydraulic cylinders 48 and 50 are reversed, to move the plates 44 and 46 inwardly toward the center of the vessel 12 to positions close to the initial positions. Opposite outer lateral edges of the bodies 40 and 42 are displaced inwardly toward each other. The result is a squeezing or compressing effect on the bodies 40 and 42, and a thickening of the plastisol film. Juxtaposed inner edges of the plastisol bodies 40 and 42 meet at an irregular but clearly defined interface 52. Alternatively, the bodies 40 and 42, by a simple inward or inward and outward movement of the plates 44, 46, are compressed.

Also seen in FIG. 2 is an exemplary means whereby a variegated or marble-like pattern may be obtained from the plastisol bodies 40 and 42. A pulley 54, driven by the shaft 56 of a motor 58 is coupled to an endless belt 60 extending transversely across the vessel 12. A pulley 62, spaced from the pulley 54 and pivoted on the vessel 12 by a pivot 64, also receives the belt 60.

Pins 66 or the like extend from an edge of the belt 60 into contact with bottom surfaces of the plastisol bodies 40 and 42. Rotation of the pulleys 54, 62 causes side-to-side motion of the pins 66, and consequently, causes intermingling of the different colored material forming the bodies 40 and 42.

FIG. 5 and 6 show examples of the variegated marblelike pattern obtainable with the above-described method and apparatus. In this connection, it is pointed out that previously, it was thought that even slight mixing or agitating action of the plastisol material would result in unwanted bubbles or gaseous inclusions in the finished product. Quite unexpectedly, when the above-described bubble-preventing steps are performed on the plastisol, this undesirable effect is substantially eliminated.

The plastisol body 68 remaining after the intermingling step is subjected to gelation. The heat necessary to accomplish gelation, or, alternatively, gelation and fusion, may be provided by the support liquid 14 itself, or by external means such as heat lamps. In the illustrated case, a heating element 69, seen in dotted line in FIG. 1, provides heat for gelation of the body 68. The body 68 passes along the length of the vessel 12, propelled by the flow of support liquid 14.

In the illustrated apparatus 10, the body 68 is removed onto a continuous flexible substrate 70. The feed roll 72 of the substrate material is supported on a stand 74 located adjacent the vessel 12. Guide rollers 75 and 76 support the substrate 70 and conduct it to a take-off roller. Substrate 70 passes around the take-off roller 78, and then over a further guide roller 80. As it passes around the lowest point of take-off roller 78, the substrate 70 is in tangential lapping contact with the support liquid 14. As the body 68 advances into contact with the moving substrate 70, it is drawn off the support liquid 14. Substrate 70, with the body 68 thereon, then passes through a drying chamber 82 wherein any remnant of the support liquid 14 which may cling to substrate 70 or the body 68 is blown free by air pressure. Next, substrate 70 is conducted through a curing oven 84 wherein body 68 is heated to a temperature above the fusion temperature of the plastisol. In some instances, wherein the substrate 7 is of a suitable polymeric material, the body 68 may be fused to the substrate 70 as fusion of the plastisol takes place. Alternatively, the body 68 may be loosely and removably adhered to the substrate 70.

Plastisol bodies **40** and **42** may be extruded from the nozzles **34** and **36** at timed intervals, to provide a continuous production of bodies **68**. The rate of production is determined in part by the properties of the plastisol formulation used. It is of course necessary that the formulation gel prior to the time the body **68** arrives at the take-off roller **78**. Also, it is necessary that the speed of the take-off roller **78** be correlated with the speed of movement of support liquid **14** in the vessel **12**. The body **68**, in its gelled but unfused state, has but limited tensile strength. Accordingly, the surface velocity of take-off roller **78** and substrate **70** is preferably such that acceleration of the body **68** as it leaves support liquid **14** is minimal. In one operative apparatus for performing the present method, substrate speeds of about 20 feet per minute have been maintained.

In the illustrated apparatus for performing the present method, the bodies **68** are removed from the support liquid **14** to a substrate **70**. In fact, it has been found feasible to remove the bodies **68** directly onto a roller. The bodies **68** may then be taken from the roller by a doctor blade or the like, placed on support sheets of any suitable material, and then subjected to further processing.

Bodies **68** may be incorporated whole into a finished product. As an alternative, they may be cut into smaller particles of a desired size and shape prior to further processing.

Referring now to FIG. **7**, there is seen a representative manufactured article, namely a flooring tile, using the decorative article manufactured in accordance with the present process. The tile **86** includes a substrate member of suitable plastic polymeric material, such as polyvinyl chloride. Triangular portions **90**, cut from finished bodies **68**, are distributed over the substrate member **88**. A coating **92** of water-white plastic polymeric material, such as polyvinyl chloride, overlies the substrate member **88** and encapsulates the triangular portions **90**. Floorings including transparent overlays, such as the above-described tile **86** are not per se new. The variegated marble-like appearance of the triangular portions **90**, however, creates a highly decorative effect not heretofore practicable on a commercial scale.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof.

I claim:

1. A method of making a decorative article from plastisol comprising the steps of providing a body of liquid material immiscible with the plastisol and having a density in excess of the density of the plastisol, placing and spreading quantities of different-colored plastisol on the surface of the body, stretching the plastisol after it is placed on the body of liquid so that its film thickness is reduced substantially, and then compressing the plastisol so that the original film thickness of the plastisol is substantially restored, then intermingling the plastisol of different colors to obtain a variegated color pattern, heating the plastisol while it is supported on the body to gel the plastisol, and removing the resulting plastisol article from the surface of the body.

2. A method in accordance with claim **1** wherein said step of stretching is performed to the extent that the film thickness of the plastisol is reduced by about one-half, said compressing step being performed by displacing opposite lateral edges of the plastisol toward each other to the extent that the film thickness of the plastisol is restored to at least about 80 percent of its original thickness.

3. A method in accordance with claim **1** wherein the plastisol is gelled but not fused while the plastisol is supported on the body of liquid, and then fused after removing of the resulting plastisol article from the surface of the body.

4. A method of making a decorative article from plastisol, comprising the steps of providing a body of liquid material immiscible with the plastisol and having a density in excess of the density of the plastisol, placing and spreading quantities of different-colored plastisol on the surface of the body so that the plastisol is supported thereon, maintaining the body of liquid in continuous motion in a given direction and at a given rate so that the quantities of plastisol supported thereon move therewith, compressing the plastisol at least before the plastisol completely gels, whereby the tendency of the plastisol to form bubbles is decreased, intermingling the plastisols of different colors to obtain a variegated color pattern, terminating the compression of the plastisol and allowing the plastisol to relax prior to gelation, heating the plastisol while it is supported on the body of liquid to gel but not to fuse the plastisol, placing a moving substrate of flexible sheet material in surface contact with the body and the gelled plastisol so that the gelled plastisol article adheres to the substrate, conveying the gelled plastisol article on the substrate away from the liquid body, and then further heating the article to fuse the plastisol.

5. A method in accordance with claim **4** wherein the step of compressing the plastisol is performed by displacing opposite lateral edges of the plastisol toward each other to cause an increase in the film thickness of the plastisol.

6. A method in accordance with claim **4** wherein the plastisol is stretched after it is placed on the body of liquid but before it is compressed and gelled, so that the film thickness after stretching is substantially reduced.

7. A method in accordance with claim **6** wherein said step of stretching is performed to the extent that the film thickness of the plastisol is reduced by about one-half, said compressing step being performed by displacing opposite lateral edges of the plastisol toward each other to the extent that the film thickness of the plastisol is restored to at least about 80 percent of its original thickness.

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