

July 8, 1969

P. MILLER

3,454,413

METHOD OF PRODUCING CONTOURED SHEET MATERIALS

Filed Nov. 17, 1967

Sheet 1 of 2

FIG. 1

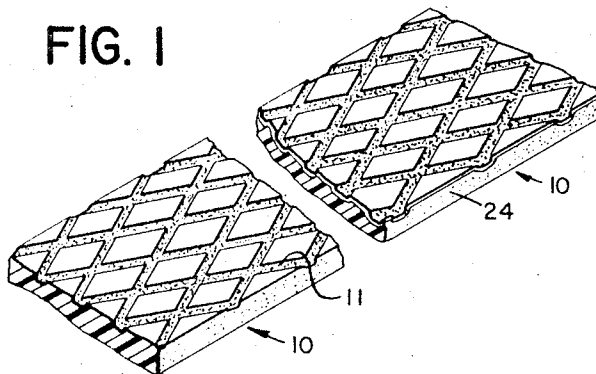


FIG. 2

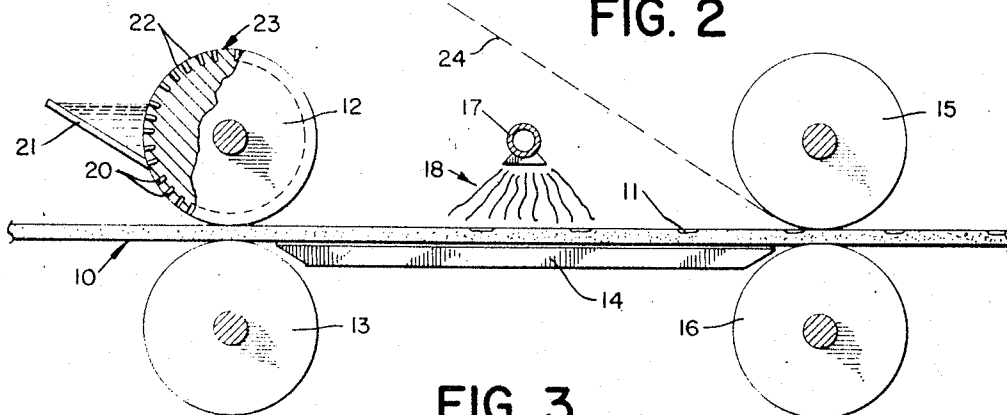
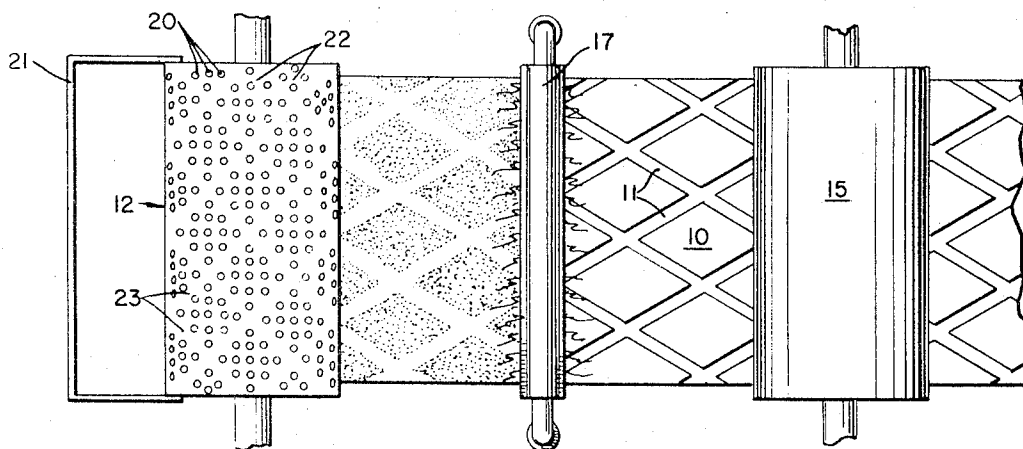


FIG. 3



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FIG. 4

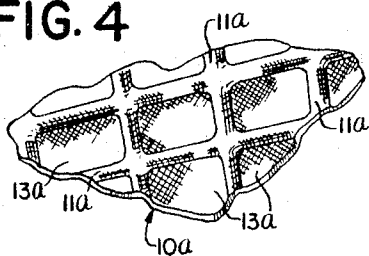


FIG. 7

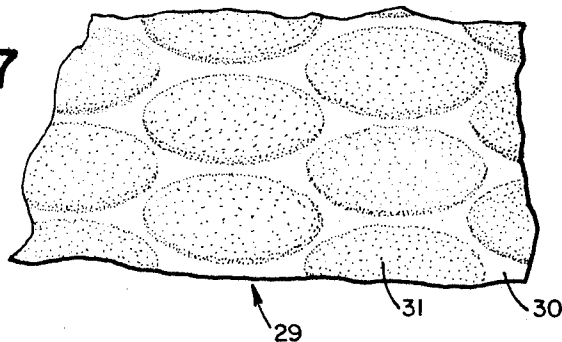


FIG. 5

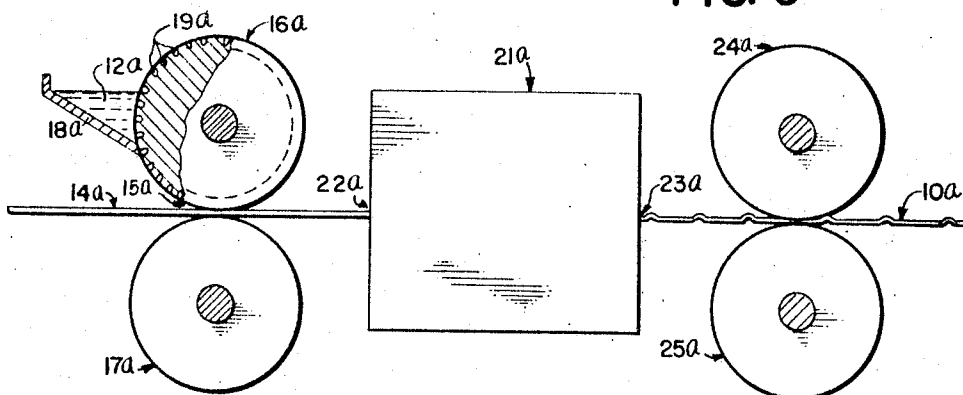
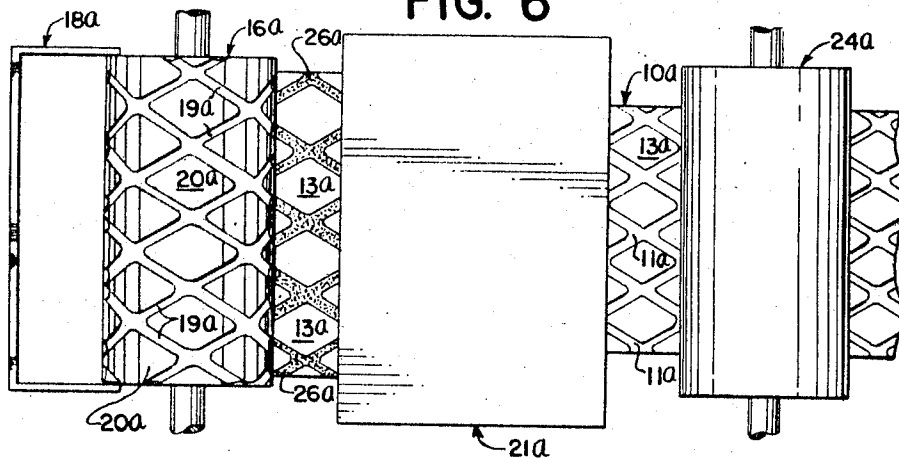


FIG. 6



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3,454,413

METHOD OF PRODUCING CONTOURED SHEET MATERIALS

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Continuation-in-part of application Ser. No. 471,279, July 12, 1965. This application Nov. 17, 1967, Ser. No. 683,838

Int. Cl. B29c 17/00, 25/00; B44c 1/02

U.S. Cl. 117—5.5

4 Claims

ABSTRACT OF THE DISCLOSURE

There is described a process for embossing a sheet material by printing a pattern on selected portions of the sheet material with a heat retarding liquid and subjecting the sheet material to a heat source to cause the areas on the sheet unprotected by the liquid to become recessed in relation to the protected areas, thereby producing a decorative article whose contours conform substantially to the printed pattern. Decorative articles for home furnishing, wearing apparel, etc., may be produced in accordance with the disclosure in the form of laminated or unlaminated batting materials, pile materials, or other fabrics.

This application is a continuation-in-part of application Ser. No. 381,710, filed July 10, 1964 and application Ser. No. 471,279, filed July 12, 1965, both of which applications are now abandoned.

Numerous techniques for producing decorative articles of manufacture such as wearing apparel, home furnishings, etc., are disclosed in the prior art. It is known that an embossed article may be produced by depositing in pattern form, an adhesive on selected areas of a foam material and thereafter securing an overlying fabric material to the foam material in those areas where the adhesive pattern is printed so as to reproduce the printed pattern on the overlying fabric material. Contoured articles may also be produced with a multiple-needle sewing machine. Limitations exist with respect to such contoured three-dimensional fabrics produced on a multiple-needle sewing machine in the type of decoration producible. Also such a sewing process is relatively expensive due to the slow speed of operation.

Accordingly, one aspect of the present invention is to provide a relatively simple process for producing highly decorative monolayer or multilayer sheet materials in which there are practically no limitations on the type of pattern of decoration producible.

Another aspect of the present invention is to produce contoured sheet materials by means of printing thereon a pattern with a liquid heat resisting material and subjecting the sheet material to a heat source to cause the areas unprotected by the liquid material to become recessed below the liquid protected areas.

A further aspect of the present invention provides for printing of a pattern on a sheet material having voids with a liquid material comprising water so as to cause those areas unprotected by the liquid material to become fused and recessed below the protected areas upon the application of heat to the sheet material.

Yet another aspect of the present invention is to contour normally flat sheet materials such as batting, pile

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fabrics, etc., by printing thereon a pattern with a liquid heat resisting material and exposing the printed surface to a heat source to produce a decorative fabric having selected portions recessed below other portions to produce a sculptured effect.

It is still another aspect of the invention to vary the depth of the contoured pattern by regulating either the amount of heat-absorbing liquid printed on the sheet material or the length of time during which the material is exposed to the heat or both.

An additional aspect of the invention is to produce multilayer articles by printing a pattern on a base sheet material with a liquid heat resisting material and securing an overlying fabric to the base sheet material in selected areas of the base sheet to thereby reproduce the pattern on the surface of the overlying fabric.

Other aspects and features of the invention will be apparent when the following description is considered in connection with the annexed drawings, in which:

FIGURE 1 is a perspective view of a foam sheet embossed in accordance with my invention, a portion of the embossed sheet being shown with a fabric covering laminated thereto and having the same embossed form as the underlying sheet;

FIGURE 2 is a diagrammatic side elevation showing a means for feeding a sheet of foam material between a pair of rollers, one of which prints a desired pattern upon the upper surface of the sheet with water or other heat absorbing liquid. This view also shows a plate upon which the sheet of foam material lies as it passes from the first or printing rollers to a second set of feed rollers and likewise shows a flame which extends across the sheet in the area between the rollers;

FIGURE 3 is a top plan view of the mechanism of FIGURE 2;

FIGURE 4 is a perspective view of a heat shrunk fabric ornamented in accordance with the invention;

FIGURE 5 is a diagrammatic side elevation showing of a suitable apparatus for producing contoured heat shrinkable articles in accordance with the invention;

FIGURE 6 is a top plan view of the mechanism of FIGURE 5; and

FIGURE 7 is a perspective view of a pile fabric ornamented in accordance with the invention.

The process of the present invention may be employed to produce decorative articles of manufacture from sheet materials for use in wearing apparel, home furnishings, etc. The selection of a particular type of sheet material is not critical to the process except that it be a material which can be contoured by selective heating in predetermined areas. Included among suitable sheet materials are foam type materials and polymeric fiber containing materials. The foam material may be a foamed polyurethane of either the polyester or polyether type. The polymeric fiber containing materials include fibrous batting such as batting made from nylon fiber, polyester fiber or any fiber having a thermoplastic binder such as vinyl acetate or acrylic resin; a heat shrinkable fabric whose fibers lie substantially in the plane of the fabric such as for example, ninon greige goods, "Rhovyl-55" (a polyvinyl chloride fiber), "Herculon" (an olefin fiber), tricot fabric, e.g., tricot with a trilobal monofilament, etc. Preferably the heat shrinkable material is a fabric which shrinks at least approximately ten percent when heat shrunk; pile fabrics, e.g. carpeting having a pile which consists of polymeric fibers such as olefin fibers (e.g.,

polypropylene, acrylics, etc.), velvet fabrics, etc., napped tricots, etc.

Turning now to the drawings, FIGURE 1 illustrates a sheet 10 of foam material which, as indicated, may be polyurethane foam of either polyester or polyether type having a pattern in the form of a grid of depressed areas 11 therein. It will of course be understood that the grid pattern indicated is for illustrative purposes only and that any desired pattern may be formed.

The depressed areas 11 are areas in which the foam material has been melted and fused and the air expelled from the cells, thus causing collapse of the material and a fusing which causes these areas to be depressed as stated.

Referring now to FIGURE 2 there is shown therein a simple apparatus for performing the printing and exposure to flame which, as discussed above, results in the article of FIGURE 1.

The unembossed foam sheet which may be for example a quarter inch thick sheet is passed between the rollers 12 and 13, thence over a plate 14 and into the bight of a second pair of rollers 15 and 16. Above the plate 14 is a perforated pipe 17 through which fuel is conducted to form the flame 18 which plays upon the upper surface of the sheet 10. Also, as shown in this figure, printing roller 12 has small recesses 20 of predetermined depth drilled or otherwise formed therein and bears against the surface of the material 10. The patterned recesses in roller 12 are wetted with water by means of a trough formed by a doctor blade 21 which extends longitudinally of the roller 12 and the upper surface of the roller 12 is wiped clean by doctor blade 21. As is clearly indicated in FIGURE 3, the recesses 20 of the printing roller 12 are arranged in the desired pattern.

As will be obvious, the foam material is printed with a block pattern defined by the areas 23 on the printing roller 12 as the material passes between the rollers 12 and 13. The water utilized and deposited in the holes 20 may, if desired, be combined with a thickening agent such as "acrysol" ASE-60 produced by the Rohm & Haas Company or with other thickening agents such as starch or methyl cellulose to facilitate the printing and to control the depth to which the water or other agent may be impregnated.

As the material passes from the printing rollers 12 and 13 to the takeup rollers 15 and 16, it passes beneath the flame 18. Since the areas which have been impregnated with water by the printing roller have their temperature reduced due to the latent heat of vaporization of the liquid, these areas are heat resistant and retain their original cellular structure. The unprinted areas, however, become heated to a sufficient temperature (with the material mentioned approximately 450° F.) to fuse the polyester thereby breaking down the cellular structure in the desired areas to a regulated depth and collapsing the material so that the surface thereof lies beneath the surface in the water impregnated areas. The takeup rollers 15 and 16 are normally placed sufficiently far from the flame 18 so that the fused material has reset and lost its tacky characteristic and thus has no tendency to adhere to the roller 15.

However, if desired, the rollers 15 and 16 may be placed somewhat closer to the flame 18 and a fabric sheet indicated in dotted lines at 24, FIGURE 2, be laminated to the surface of the foam material. As will be obvious, this fabric sheet will adhere to the foam material only in the grid pattern formed by the lines or areas 22 of the printing roller or cylinder 12. Thus the overlying fabric layer 24 will likewise be embossed since it will follow the contours of the underlying foam material 10 and will, in the instance illustrated, have the grid pattern of the lines 11 of FIGURE 1 visible therein.

Although the simple apparatus described is sufficient to form the article as set forth above, it will be understood that the water or other liquid fire resistant material may

be printed on the foam by conventional rotogravure printing methods as described, for example, in Miller Patent No. 3,070,476, assigned to the assignee of this application. It is obvious that the laminating of the fabric to the upper surface of the material may be done in the usual manner by a series of rollers rather than by a single roller as shown.

Moreover, if desired, the selected sheet material may be maintained in a stretched position during the lamination of the fabric thereto as shown in my copending application Ser. No. 330,357, filed Dec. 13, 1963 (now U.S. Patent No. 3,352,741) to thereby assure that sufficient fabric is present to permit the base sheet material to return to its normal shape, that is, sufficient material so that the sheet material is not maintained in a compressed condition due to the fabric being taut between the areas of adhesion. In some instances, the base sheet material may be stretched sufficiently so that when it is released and returned to its normal form, a slack portion is left in the overlying fabric forming small folds and enhancing the decorative effect of the material as is also set forth in my copending application above-mentioned.

Also, particularly when the water has been suitably thickened by the incorporation of agents mentioned hereinabove, the amount of liquid printed on the foam sheet material may be varied resulting in different degrees of depression of the various areas since the foam sheet material having lesser amounts of water thereon will be melted to a greater degree than will those having greater amounts and of course material having no water impregnation will be melted away or fused to the greatest depth.

The variation in amount of water deposited may also be accomplished by varying the depth of the small recesses or depressions 20 in the printing roller 12 thus varying the amount of water deposited upon the base sheet.

In some instances it is desirable to utilize my method in producing embossed foam sheeting having a fabric backing laminated thereto and having the embossed areas of a depth extending substantially or completely to the backing material. As is readily understood, this can be easily accomplished by impregnating the printed areas to a considerable depth with liquid so that the melting and fusing of the unprotected areas extends substantially to the backing material thus resulting in a sheeting having "stripes" of foam material laminated thereto forming "hinges" between the stripes rendering the material flexible and readily draped for use in clothing and the like.

In FIGURE 4, there is illustrated a heat shrunk fabric 10a having its fibers lying substantially in the plane of the fabric which may be a nonheat-set nylon fabric made from a polyester or type 6 nylon filament, "Rhovyl-55," "Herculon," etc., having a pattern in the form of puckered areas 11a thereon.

The puckered areas 11a are areas in which the fabric 10a has been printed with water or other heat-absorbing material 12a as previously described in connection with FIGURES 1-3 and the areas without any substantial puckering 13a correspond to unprinted areas. The unwetted areas shrunk upon the application of sufficient heat causing the printed areas, substantially unaffected by the heat, to pucker.

Referring now to FIGURE 5, there is shown therein an apparatus for performing the printing and exposure to heat of a heat-shrinkable sheet material to produce a puckered article as illustrated in FIGURE 4.

A substantially heat-shrinkable fabric 14a is passed through a nip 15a between rolls 16a and 17a. Roll 16a is a gravure or engraved roll which is inked in any suitable manner as by water or other heat-absorbing material 12a applied by a doctor blade 18a.

In the embodiment shown in FIGURE 6, the roll 17a is a smooth-surface cylinder which may be made of metal, or rubber or metal coated with rubber or otherwise suitably constructed. Roll 17a may be caused to be rotated at a speed synchronized with that of roll 16a.

The surface of the roll 16a contains engraved or otherwise produced recesses 19a. Each of these recesses is inked by water, preferably thickened water or other heat-absorbing liquid material 12a which is temporarily retained in the recess by capillary action, adhesion, or otherwise. As the substantially shrinkable fabric 14a is fed through the nip 15a between rollers 16a and 17a, recesses 19a which contain the heat-absorbing material are gradually brought in compressive contact with fabric 14a and commerce to deposit the heat-absorbing material onto the fabric 14a. The quantity of the heat-absorbing material thus imprinted corresponds generally to the depth of the recesses from which the heat-absorbing material is deposited.

As indicated in FIGURE 6, the recesses 19a of the printing roll 16a are arranged in the desired pattern. The shrinkable fabric 14a is printed with a block pattern (for purposes of illustration) defined by the areas 20a on the printing roll 16a as the fabric passes between rolls 16a and 17a.

After the substantially shrinkable fabric 14a passes between rolls 16a and 17a and has the desired pattern printed thereon, it is exposed to a heat source. In FIGURE 4, the heat source is an oven 21a having openings 22a and 23a for the ingress and egress of fabric 14a. Rolls 24a and 25a along with rolls 16a and 17a serve to guide fabric 14a into openings 22a and 23a for the ingress and egress of the fabric.

As the printed fabric 14a passes into the oven 21a, the areas 26a which have been impregnated with water by printing roll 16a have their temperature reduced due to the latent heat of vaporization of the water. Thus, these areas 26a are heat resistant whereas the unprinted areas 13a became heated to a sufficient temperature (with polyester nixon fabric approximately 350° F.) to shrink the fabric in the unprinted areas. As a result of shrinkage, the surface of the water-printed areas will rise above the surface of the nonimpregnated areas thereby producing a puckered effect. The shrinkage of fabric 14a can be seen in FIGURE 5 as it passes out of oven 21a. The specific form of heating apparatus used is not critical, of course, and electrical or other infrared heaters or other devices may be employed. It is only required to heat the dry fabric portions to shrink temperature without overheating.

After the ornamented fabric passes between rolls 24a and 25a it may be fed to a wind-up roll (not shown). Secondary low temperature heating apparatus may be employed to dry out the fabric if desired.

FIGURE 7 illustrates a contoured pile fabric 29 obtained in accordance with the process of the present invention. The depressed areas 30 are those in which no liquid pattern was printed and the areas 31 comprising the pile fibers which correspond to the areas of the pile fabric on which a liquid pattern was printed.

A contoured pile fabric such as illustrated in FIGURE 7 may be obtained by printing the liquid pattern by gravure, silk screen or other methods of applying prints to fabrics.

A contoured napped nylon tricot was contoured in accordance with the procedure illustrated in FIGURES 2 and 3 of the drawings. A water pattern was applied with a gravure roll which prints to a depth of about .010 inch. At this depth, the nap which is about .02 inch deep is saturated to the back. After this pattern is printed on the napped nylon tricot (e.g., type 6 nylon), the fabric is exposed to a flame so that when the fiber reaches a temperature between about 350°–450° F. significant loss of pile height occurs in the nap due to shrinkage.

The water used to contour the pile fabric contained a sufficient quantity of thickening agent as previously described to obtain a viscosity in range of about 500 to 1000 cps. This reduces the lateral migration of the liquid and facilitates the printing of a well defined pattern.

Carpeting with a pile of 0.25 inch was also contoured in accordance with the process of the present invention. The pile consisted of polypropylene fibers. Preferably an engraving roll is used that will wet approximately 10 to 30% of the depth of the surface of the pile. After the liquid pattern is printed in the manner previously described, the carpeting is exposed to a heat source which results in the contoured article. It is believed that this effect is caused by the fibers shrinking, melting or fusing in the unprotected areas when the polypropylene pile fibers reach a temperature of about 250° F. At least 10% reduction of pile will occur in the unprotected areas. The reduction of pile in the unprotected areas can be increased by increasing the time exposure of the carpeting to the heat source.

Among other materials contoured in accordance with the process of the present invention was tricot with a trilobal nylon monofilament (e.g., Antron). The glossy face filament in this tricot appears to shrink into the body of the dull multifilament nylon substrate knit of the fabric. The substrate is a material which has a higher melting point than the face filament. Those areas of the tricot fabric protected by the pattern are not affected by exposure to a heat source.

Other variations are contemplated by the present invention. The degree of ornamentation and sculpturing may be altered by modifying the viscosity of the liquid heat resisting material printed in pattern form on the sheet material, varying the depth of the recesses in the printing roll, etc. The visual effect produced may also be further enhanced by including a dye material in the printing liquid.

The contoured sheet material of the present invention are particularly useful as a decorative material such as for clothing, home furnishings and in other applications where decoration is desired. Also, the article of the present invention can be used for insulation purposes such as for clothing lining, bed covers, etc., by laminating the decorative article to an insulation material such as polyurethane foam.

I claim:

1. The method of producing a contoured pattern in a sheet material selected from the class consisting of a foam material and a polymeric fiber containing material which comprises protecting a pattern of selected areas of said sheet material from heat with a liquid comprising water applied in said selected areas and exposing the surface of said sheet material to a heat source to thereby cause the unprotected areas to become recessed in relation to said protected areas, thereby producing contours in said sheet material in substantial conformity with said pattern.

2. The method of producing a contoured foam sheet material having voids therein which comprises feeding said sheet between a pair of rollers and simultaneously printing a pattern on one surface of said foam sheet material with water, passing said foam sheet material through a flame under urge of a pair of takeup rollers and regulating the speed of said printing and takeup rollers to cause said flame to fuse said foam material in the unprinted portions, thereby reducing the voids of said foam sheet material in said unprinted portions and depressing the surface below the surface of the printed areas, the speed being such that sufficient heat is absorbed by said water to prevent fusing and reduction of the voids in said printed areas.

3. The method of producing a contoured pattern in a substantially heat shrinkable fabric which comprises protecting a pattern of selected areas which are to be the raised areas in the finished product from heat with a liquid comprising water printed in said selected areas and exposing the surface of said shrinkable fabric to a heat source to thereby cause substantial shrinkage in the unprotected areas of said fabric resulting in said protected

areas of said fabric being raised in relation to said unprotected areas.

4. The method according to claim 3 wherein said heat shrinkable fabric is a material whose fibers lie substantially in the plane of the fabric.

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U.S. Cl. X.R.

117—38, 46; 156—209; 161—119; 264—80, 321