PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
B32B 31/12

A1

(11) International Publication Number: **WO 96/24490**

(43) International Publication Date: 15 August 1996 (15.08.96)

(21) International Application Number: PCT/US96/02013

(22) International Filing Date: 6 February 1996 (06.02.96)

(30) Priority Data:
08/385,669 8 February 1995 (08.02.95) US

(71) Applicant: LENTICULAR PLASTICS, INC. [US/US]; 315 Linden Place, Westbury, NY 11590 (US).

(72) Inventors: KARSZES, William, M.; 2720 Roxburgh Drive, Roswell, GA 30076 (US). PINTO, Vito, Charles; 315 Linden Place, Westbury, NY 11590 (US).

(74) Agents: CINAMON, Jay, S. et al.; Abelman Frayne & Schwab, 150 East 42nd Street, New York, NY 10017-5612 (US).

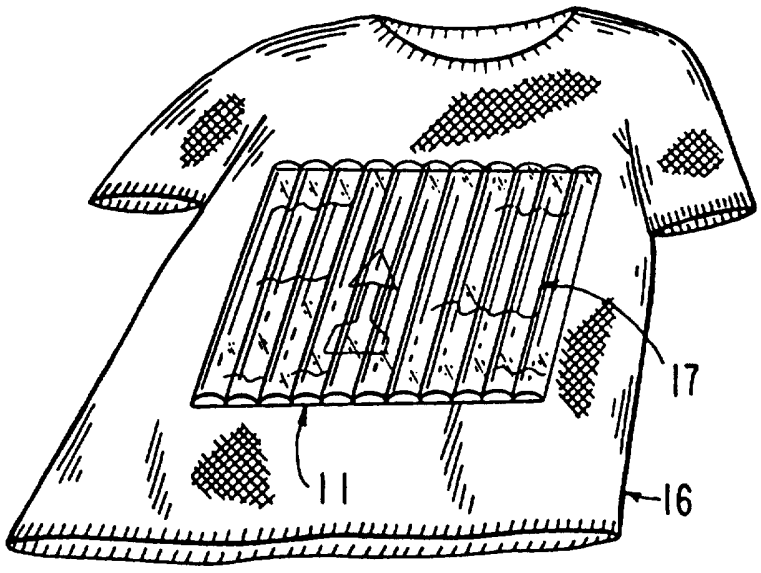
(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AZ, BY, KG, KZ, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: DECORATIVE SYSTEM FOR APPAREL AND METHOD OF MAKING SAME

(57) Abstract

A method of printing images (17) on lenticular plastics (11) and bonding them to a fibrous substrate (16) to form a laminate by the joint use of a pressure sensitive adhesive and a heat sensitive adhesive, or by welding without or with an adhesive(s), to produce articles of apparel, or other fibrous articles, possessing a photorealistic appearance of a 3-D image, or an animated image, or a stereogram, or a hologram. A method of achieving brilliant and sharp 2-D printed images on non-lenticular plastics and bonding them to a fibrous substrate to form a laminate by the joint use of a pressure sensitive adhesive and a heat sensitive adhesive, or by welding without or with an adhesive(s), to produce articles of apparel, or other fibrous articles, possessing a photorealistic 2-D image.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia
AT	Austria
AU	Australia
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CS	Czechoslovakia
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GE	Georgia
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgystan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakhstan
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LT	Lithuania
LU	Luxembourg
LV	Latvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
MX	Mexico
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SZ	Swaziland
TD	Chad
TG	Togo
TJ	Tajikistan
TT	Trinidad and Tobago
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan
VN	Viet Nam

DECORATIVE SYSTEM FOR APPAREL AND METHOD OF MAKING SAME

BACKGROUND OF THE INVENTION

The present invention relates to a method of printing images having enhanced visual and optical characteristics and decorative appeal onto the surface of a plastic sheet and laminating the printed plastic sheet onto a fabric substrate. More particularly, the invention relates to a method, and an article formed by that method, of printing novel optical images possessing depth of field, i.e., three-dimensional and/or the appearance of motion, i.e., animated imagery, on the surface of a sheet of a lenticular plastic and, thereafter, bonding such lenticular sheet bearing such printed image to an article having a fibrous layer such as, an article of wearing apparel, a trading card, a promotional piece, etc., so that the image is distortion free. The invention also relates to a method of printing flat two-dimensional images on a non-lenticular plastic layer which possesses brilliance of color and a sharp image, and an article formed by that method.

The most extensive and widespread form of printing employed in the apparel and textile industries is screen printing. However, images which are produced by screen printing are neither as sharp, nor as brilliant as are achievable by other known forms of printing. For example, offset lithography serves to produce images of greater

clarity and brilliance, however, such methods cannot be readily employed in the printing of textile fabrics.

In the past, attempts have been made to print images on the opaque surface of a variety of plastics, such as polyvinyl chloride, polyethylene, or polypropylene. However, in order to be able to protect the print on the opaque surface of such plastic sheets by the various available printing technologies, such as lithography, flexography, or gravure printing, it was necessary to place a protective finish of some type, such as a solvent coating, or a urethane coating, or a UV coating over the printed image on the opaque surface. The results achieved were inadequate due to lack of lustre and durability.

Efforts to print three-dimensional images or animated imagery on, for example, polyvinyl chloride, as well as other plastics, and then bond the image-bearing plastic to a fabric substrate, have all met with limited success. This, too, is due to lack of durability.

One of the prime problems which was encountered was that in fabricating the plastic sheet, excessive quantities of plasticizer were employed, or softer grades of plastic, e.g., polyvinyl chloride, were employed so, that in either event, the heat distortion temperature was so excessively low that the plastic sheet could no longer be employed for its ultimate intended usage. To wit, the article of apparel bearing the imprinted plastic image bonded thereto, could not meet certain minimal criteria, namely, the ability to withstand six (6) washing/drying cycles and,

further, the adhesive or bonding systems employed to achieve adhesion and registry failed with consequent distortion of the image.

With the advent of specialized plastics, namely, thermoplastic elastomers, which allow the fabrication of lenticular plastics with greater handle and durability, the ability to print images thereon which will yield the visual effect of depth, i.e., three or more dimensions, and/or motion, i.e., animated imagery, has resulted in considerable improvement. However, notwithstanding the development of improved lenticular plastics, attempts at successfully bonding the image-bearing lenticular plastic, to the apparel fabric is still beset by the problems of the prior art, namely, image distortion, stiffness and brittleness (resulting from the inability to withstand repeated wash/dry cycles), yellowing and the inability to withstand heat without loss of physical properties, which are due to the inability of the available bonding systems to address the foregoing problems.

The foregoing problems also exist with respect to printing flat two-dimensional, or special effect two-dimensional printing, when using non-lenticular plastics. In this case also the printed image suffers from a lack of sharpness, brightness and clarity and it, too, is subject to the problems of image distortion, brittleness upon repeated washings, as well as yellowing and the inability to withstand heat without loss of physical properties. The aforementioned problems with respect to two-dimensional

images imprinted on plastic also suffers from the inability to develop bonding systems which will successfully permit the plastic bearing image to adhere to the textile substrate which is formed into the article of apparel.

SUMMARY OF THE INVENTION

In one aspect or embodiment of the present invention there is provided a method of producing photorealistic optical or visual effects selected from the group consisting of three-dimensional images, animated imagery, stereograms and holograms by an image printed on a lenticular plastic layer laminated to an article having a fibrous layer, which comprises:

(a) printing the reverse of the image on the back surface of a lenticular plastic sheet;

(b) laminating the printed image on the back surface of a lenticular plastic sheet by means of a pressure sensitive adhesive layer with the other surface of the pressure sensitive layer bonded to one surface of a heat sensitive adhesive layer, while the other surface of the heat sensitive adhesive layer is bonded to the article of apparel.

By printing directly on the back or rear surface of a lenticular plastic sheet without the need of interposing

any type or protective coating, one can print and effectively transfer a photorealistic image, be it three-dimensional, multi-dimensional imagery, animated, stereograms or holograms, to an article of apparel, or in fact any fibrous containing article, such as a trading card, or promotional piece, which is made of cellulosic fibers, which will stay bonded thereto by virtue of the joint use of a heat sensitive layer and a pressure sensitive layer to provide an image which gives the appearance of depth and/or motion, while preventing distortion of the image. In the case of an article of apparel, even after repeated wash and dry cycles the adhesive system of the present invention will prevent the article from becoming stiff and brittle.

In another aspect of the invention photorealistic optical or visual effects which produce the appearance of depth and/or motion are achieved by an image printed on a lenticular plastic layer laminated to a fibrous layer, without distortion of the image which comprises:

(a) printing the reverse of the image on the back surface of the lenticular plastic sheet; and

(b) bonding the lenticular plastic to an article having a fibrous layer by welding whereby the lenticular plastic is melt bonded to the fibrous-layered article, i.e., article of apparel, trading card, etc. Alternatively, in this aspect of the invention a heat sensitive

adhesive layer can be inserted or interposed between the article of apparel and the printed lenticular plastic. In certain instances, both a pressure sensitive adhesive layer and a heat sensitive adhesive layer can be so interposed.

In yet another aspect or embodiment of the subject invention, an article of apparel, or in fact any article containing a fibrous layer, having an optical effect selected from the group consisting of three-dimensional images, animated imagery, stereograms and holograms laminated thereon, produce the appearance of depth and/or motion while preventing distortion of the image, which comprises:

(a) a lenticular plastic layer having the reverse of a three-dimensional image, animate image, stereogram or hologram printed on the back surface of the lenticular plastic;

(b) said lenticular plastic layer bonded to a surface of a pressure sensitive adhesive layer, the other surface of said pressure sensitive adhesive layer being bonded to a surface of a heat sensitive adhesive layer; and

(c) the other surface of said heat sensitive layer being bonded to the fibrous-layered article to form a laminated article.

In still another aspect or embodiment of the present invention, an article of apparel or an article containing a fibrous layer, having an optical effect selected from the group consisting of three-dimensional images, animated images, stereograms and holograms thereon to produce the appearance of depth and/or motion while preventing distortion of the image, which comprises:

(a) a lenticular plastic layer having the reverse of a three-dimensional image, an animated image, a stereogram, or a hologram printed on the back surface of a lenticular plastic layer;

(b) said lenticular plastic layer being melt bonded to the article of apparel or the fibrous-layered article by welding.

In other aspects or embodiments of the invention, methods of creating two-dimensional printed images on the back surface of a non-lenticular plastic sheet and thereafter laminating the printed image by means of pressure sensitive adhesive layer and a heat sensitive adhesive layer is set forth, as well as articles made in accordance with said method. Also disclosed is the method of producing a two-dimensional printed image whereby the non-lenticular plastic bearing the printed image is melt bonded by welding to the article containing a fibrous layer. Alternatively, during the welding operation a heat sensitive adhesive layer may be inserted between the

article and the printed non-lenticular plastic sheet, or in addition, a pressure sensitive adhesive layer may be inserted between the heat sensitive adhesive layer and the printed non-lenticular plastic sheet.

Other embodiments of the invention are articles of apparel, or articles possessing a fibrous layer, having two-dimensional images thereon which are made in accordance with the method of the present invention described immediately above and which results in articles having brilliant and sharp printing and which has eye appeal, i.e., will catch and hold the eye of the viewer.

BRIEF DESCRIPTION OF THE DRAWINGS

Some of the features and advantages of the invention having been stated others will become apparent as the description proceeds, when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view of a lenticular plastic layer in accordance with the present invention;

FIG. 2 is a perspective view of a lenticular plastic layer with a reverse image printed on its back surface in accordance with the present invention;

FIG. 3 is a perspective view of a lenticular plastic layer having a reverse image on the back surface thereof and having the adhesive system of the

present invention adhered thereto;

FIG. 4 is a perspective view of a lenticular plastic layer of the present invention, having a reverse image printed on the back surface thereof, a two-layer adhesive system laminated to a fibrous substrate in accordance with the present invention;

FIG. 5 is a perspective view of an animated image of an arrow printed on the back surface of a lenticular plastic in accordance with the present invention;

FIG. 6 is a perspective view of an animated image of an arrow printed on the back surface of a lenticular plastic layer in accordance with the present invention;

FIG. 7 is a perspective view of a three-dimensional image of a house printed on the back surface of a lenticular plastic layer in accordance with the present invention;

FIG. 8 is a perspective view of a non-lenticular plastic layer in accordance with the present invention;

FIG. 9 is a perspective view of a non-lenticular plastic layer with a reverse image printed on its back surface in accordance with the present invention;

FIG. 10 is a perspective view of a non-lenticular plastic layer having a reverse image on the back surface thereof and having the adhesive system of the present invention adhered thereto;

FIG. 11 is a perspective view of a non-lenticular plastic layer of the present invention, having a reverse image printed on the back surface thereof, a two-layer adhesive system laminated to a fibrous substrate in accordance with the present invention;

FIG. 12 is a plan view of a two-dimensional image of a rocket printed on the reverse surface of a non-lenticular plastic layer which is adhered to a tee-shirt in accordance with the present invention.

FIG. 13 is a perspective view of a lenticular plastic layer welded to a fibrous substrate in accordance with the present invention; and,

FIG. 14 is a perspective view of a non-lenticular plastic layer welded to a fibrous substrate in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In accordance with the present invention, the plastic layer or sheet, whether it is lenticular in nature or non-lenticular in nature, must possess certain attributes or characteristics in order to achieve a suitable image possessing the appearance of depth and/or motion, as well as brilliant and sharp printing which catches and holds the eye of the viewer, in the case of lenticular plastics, as well as sharpness of image and brilliance of color in the case of a flat two-dimensional image printed on a non-lenticular plastic.

It has been found that any clear, flexible polymer, such as, for example, thermoplastic elastomers, polyvinyl chloride, polypropylene and polyethylene can be employed in the present invention. In those instances where the perception of depth, e.g., 3-D, or motion, e.g., animated imagery is sought to be achieved, a lenticular plastic, which is a sheet or layer of plastic that has a series of lenses running along its length, is required. Where the appearance or perception of depth is not needed, a non-lenticular plastic can be employed for two-dimensional printing.

Such lenticular plastics or non-lenticular plastics can be made by well-known prior art methods, such as calendaring, injection molding, hot pressing, etc, and can be employed in accordance with the present invention. However, it is preferred that the lenticular optical plastic, or the non-lenticular plastic, employed in accordance with the present invention be the product produced by Plastic Associates, Inc., Roswell, Georgia.

It has been found that thermoplastic elastomers are particularly suitable for the manufacture of plastic sheets having a lenticular configuration or a non-lenticular configuration for use in accordance with the method and article of the present invention. Among the thermoplastic elastomers which can be employed in accordance with the present invention are, for example, a thermoplastic polyurethane, a thermoplastic urethane with an ether backbone, a thermoplastic urethane with an ester backbone,

olefinic thermoplastic vulcanizates, thermoplastic olefins, styrene block copolymers, copolyesters and copolyamides. All of these plastics possess certain physical and chemical qualities which make them particularly suitable for use in accordance with this invention. These qualities are handability or feel, the ability to be washed and dried repeated times without becoming brittle or stiff, optical clarity and printability. The preferred thermoplastic elastomer is a urethane, especially a thermoplastic polyurethane which has either an ether or ester linkage in its backbone. Most preferred, is a thermoplastic polyurethane having either an ether or ester linkage in its backbone and having a Shore A hardness between about 70 and about 120. The preferred thickness is from about 3 mils to about 30 mils.

Initially, the reverse of the desired image, be it a depiction of an animal, an athlete, a cartoon character, etc. is printed on the back or rear surface of the lenticular or non-lenticular plastic sheet. The reverse of any of the foregoing images is imprinted on the back surface or rear surface of the plastic sheet by means of, for example, lithography, flexography and, in certain specialized circumstances, gravure printing. All of these printing methods as well as others, will insure a degree of clarity and brilliance of color, for example, four color printing with its infinite number of colors, which will serve to provide eye appeal, or "catch the eye", when the plastic sheet bearing the image is laminated to the textile

fabric layer such as a converted or unconverted article of apparel, or other fibrous layer, as will be described hereinafter. Any of the foregoing printing methods will provide greater clarity, brilliance of color and sharpness of image than will screen printing, which is conventionally used when printing textiles fabrics for use in wearing apparel. The thickness and gloss of the plastic provide lustre and depth of image. These factors add photographic reality to the image.

In its preferred embodiment the reverse image is printed on the plastic sheet using a sheet fed lithographic press with UV inks. While a sheet fed lithographic press is preferred, a continuous web press may also be used to advantage. Additionally, while UV (ultraviolet) inks are preferred for use in accordance with the present invention other inks may be used to good advantage, such as waterless inks and vegetable-oil based inks.

After the reverse of the desired image has been printed on the back or rear surface of the lenticular or non-lenticular plastic sheet, the plastic sheet is then either laminated by adhesively bonding it to a converted item of apparel having a fibrous layer, for example, a jacket, cap, T-shirt, or to an unconverted fibrous apparel layer, or welded to a converted or unconverted item of apparel, or to any material having a fibrous layer or surface, such as a trading card, an advertising brochure, a promotional piece, etc.

In the figures which follow, like numbers denote like

parts. Referring to FIGS. 1-4 generally, which is an embodiment of the present invention, FIG. 1 depicts a lenticular plastic layer or sheet 1, which has been described previously and will be described further hereinafter, which results or yields a photorealistic three-dimensional or multi-dimensional image, an animated image, holograms and stereograms of unusual sharpness and brilliance which are free of distortion.

The reverse of an image, either animate or inanimate in nature, is then printed by lithography, for example, on a back surface 2 of lenticular plastic layer 1, as can be seen in FIG. 2. Thereafter, as can be seen in FIG. 3, the image-bearing surface 2 of layer 1 is bonded or laminated to an upper layer, which is a pressure sensitive adhesive layer 3, and also to a lower layer, which is a heat sensitive adhesive layer 4.

As can be seen by reference to FIG. 4, the heat sensitive adhesive layer 4 is bonded to a fibrous substrate layer 5. The fibrous substrate layer can be a converted article of apparel, such as a tee-shirt, or an unconverted textile fabric. It can also be a trading card, an advertising brochure, a promotional leaflet, an item of flexible packaging, etc. For example, the image on the tee-shirt or the trading card may be, say, a professional athlete, a celebrated singer or musician, a cartoon character, a picture of an arrow, as will be described with respect to FIGS. 5 and 6 hereafter, or a house, as shown hereinafter in FIG. 7. In fact, any animate or inanimate

image which is sought to be depicted as possessing the appearance of depth and/or animation and/or motion can be employed.

In FIG. 5 there is depicted an animated image, in accordance with the present invention, of an arrow, generally denoted by the numeral 6, which has been printed on the reverse or back 2 of lenticular plastic layer 1, as set forth in FIGS. 1-4. The arrow 6 has a head 7, a shaft 8 and feathers 9. When the arrow image is viewed from the angle shown in FIG. 5, it is a so-called left-handed angle or left-sided view, with the arrow point or head 7 and the feathers 9 being seen as darkened in coloration with the shaft 8 being seen as lightened in coloration, which presents the illusion of animation by the arrow 6. The same principle would apply with respect to motion imagery whereby the color of the arow would remain the same in the left-hand and right-hand views, however, the position or trajectory of the arrow would change reslulting in, or leading to, the illusion or perception of movement or motion.

In FIG. 6, the arrow of FIG. 5 presents a different perspective or angle as viewed from the right hand side. In FIG. 6, the arrow point or head 7 and the feathers 9 are seen as lightened in coloration, while the shaft 8 is seen as darkened. The illusion presented is that the arrow 6 is animated. The motion imagery principle described with respect to FIG. 5 is equally applicable to FIG. 6.

In FIG. 7 there is depicted a three-dimensional image,

in accordance with the present invention, of a house 10, printed on the reverse or back surface 2 of lenticular plastic layer 1.

The animated images of FIG. 5 and FIG. 6 and the three-dimensional image of FIG. 7, are adhered to fibrous layer 5 by the pressure sensitive adhesive layer 3 and the heat sensitive adhesive layer 4 described in relation to FIGS. 1-4. The animated imagery or the 3-D image of FIGS. 5, 6 and 7 can be of an animate object, such as an athlete, singer, musician, cartoon character, etc., as well as the depicted inanimate images which are merely exemplary. The fibrous layer 5 of FIG. 4 can be a textile fabric which has been converted, for example, into a tee-shirt, cap, or jacket and which is either all cotton or all wool, or a blend of a naturally occurring textile fibers, such as cotton and synthetic fibers. Alternatively, the fibrous layer 5 can be a smooth, fibrous surface formed from cellulosic fibers, which have been converted into a playing card, an advertising brochure, a promotional mailing, etc.

The formation of the lenticular-adhesive laminate depicted in FIGS. 1-4, inclusive, is duplicated in the formation of the non-lenticular-adhesive laminate as depicted in FIGS. 8-11, inclusive, which is another embodiment of the present invention.

FIG. 8 depicts a non-lenticular plastic layer 11, which as described previously and will be further described hereinafter, produces or yields a photorealistic two-dimensional image of unusual sharpness and brilliance and

which is free of distortion in accordance with the process of the present invention. The reverse of an image is then printed on a back surface 12 of the non-lenticular plastic layer 11 by, say, offset lithography, as can be seen in FIG. 9. From FIG. 10 it can be seen that the image-bearing surface 12 of non-lenticular layer 11 is bonded or laminated to two adhesive layers, i.e., to an upper adhesive layer, which is a pressure sensitive adhesive layer 13, and also to a lower adhesive layer, which is a heat sensitive adhesive layer 14.

Turning next to FIG. 11, the heat sensitive adhesive layer 14 is then bonded to a fibrous substrate layer 15. The fibrous substrate layer can be a converted article of apparel, such as a T-shirt, an unconverted textile fabric, a converted cellulosic substrate such as a trading card, or an advertising or promotional brochure. As stated previously, the image can be animate, exemplary of which are a professional athlete, a cartoon character, a singer or a musician, or it can be an inanimate object.

For example, as seen in FIG. 12, the tee-shirt 16 bears a sharp and brilliantly printed two-dimensional image of a rocket 17, the reverse of which has been printed on the back surface 12 of non-lenticular plastic layer 11 as described with respect to FIGS. 5-8, inclusive.

The need for using both a pressure sensitive layer and a heat sensitive layer in combination is to prevent distortion of the image on the plastic sheet when the heat sensitive adhesive layer is bonded to the article of

apparel. If only a pressure sensitive layer were employed, then the item of apparel would not withstand or hold-up during the common wash and dry cycle. If only a heat sensitive layer were employed, the image would become distorted. It is only through the combination of the two types of adhesive layers, namely, the heat sensitive and the pressure sensitive, that the method of the present invention will function and perform satisfactorily to produce the appearance of depth, i.e., three-dimensional and/or motion, i.e., animated imagery, when using a lenticular plastic while simultaneously providing more brilliant colors and sharper printing, or provide the brilliant colors and sharp printing when a non-lenticular plastic is used for printing two-dimensional images. The pressure sensitive layer acts as a stress relief layer which allows for expansion and contraction due to wash/dry/wear cycles.

While the fabric employed in the article of apparel of the present invention can be naturally occurring fibers, such as cotton or wool, or synthetic fibers, such as polyester, or mixtures of the two, in the case of either converted or unconverted articles of apparel, or cellulosic fibers in the case of trading cards, or advertising, or mailing pieces, the invention has particular applicability when used with a textile fabric containing only naturally occurring fibers, such as cotton fibers used in 100% cotton T-shirts. The need for a heat sensitive layer becomes particularly acute when the apparel or textile substrate

consists entirely of cotton fibers. In order to be able to grab the cotton fibers in the textile fabric in the unwashed state, an adhesive system is needed that will surround the fiber and permeate the cloth or fabric. A pressure sensitive adhesive system will not accomplish this, while a solvent based system would, in fact, accomplish the foregoing, but one would necessarily, thereafter, have to drive off the solvent. Such a solvent based system is, of course, undesirable due to the lingering odor and the costs involved in removing the solvent. The most effective way of accomplishing the permeation of the cotton fibers in a short period of time is through the use of a heat activated, dry adhesive. There are a wide range of dry adhesives which will perform more than adequately in accordance with the present invention. Such adhesives are effective within a working temperature range of from about 200^{0}F and range all the way up to somewhat over about 400^{0}F. When the adhesive melts, it becomes pressed down into the fabric surface.

Exemplary of the heat sensitive adhesives which will function effectively in the process for the present invention are polyurethane, nylon, polyester or vinyl adhesives. Accordingly, one would use from about 1 mil to about 10 mils, with about 3 mils of such a heat sensitive adhesive being preferred. The nature of the heat set adhesive and its thickness, as well as the ratio of layers or materials are typical only, and do not necessarily exclude other materials, other thicknesses and other ratios

of layers.

A pressure sensitive adhesive layer is needed since it will "grab" both mechanically and chemically to tie the plastic sheet or layer bearing the imprinted image. Exemplary of the pressure sensitive adhesives which can be advantageously employed are acrylics, polyvinyl acetate, polyvinyl alcohol, polyaramids, cellulose nitrate, silicones and rubber modified derivatives of the foregoing. Acrylics are the preferred pressure sensitive adhesive, with rubber modified acrylics being especially preferred. The pressure sensitive adhesive layer allows the image-bearing surface of the plastic layer to be tied to the dry, heat sensitive adhesive layer. By the use of the pressure sensitive layer several things are accomplished simultaneously, namely:

(1) it will bond to the plastic sheet or layer bearing the image without having to melt;

(2) act as a "tie" or "buffer" layer that will serve to absorb the heat and pressure during bonding (This layer will then spread or distribute the stresses during application and use); and,

(3) the "buffer" or "tie" layer is necessary to prevent distortion to the printed image on the back or reverse surface of the plastic sheet or layer.

The pressure sensitive adhesive layer provides the

requisite protection for the image and also maintains the clarity of the plastic, which is necessary to provide a good appearance to the laminated final product. If only heat bonding were being employed by use of a heat sensitive adhesive, and no pressure sensitive adhesive were present, the plastic layer or sheet bearing the image would be protected from heating only from one side, while keeping the plastic cool only from the opposite side or surface. When appropriate temperatures, pressures and times are employed, such as from about 200^{0}F to about 450^{0}F, pressures from about 10 to about 150 psig, and preferably from about 80 psig to about 100 psig, for a period of from at least about 3 seconds at a minimum with no maximum period of time being applicable, except practically, say, 15 seconds, the pressure serves to "flow" the heat activated adhesive into the fibrous layer.

As a practical matter it has been found that certain minimal requirements are necessary for the bonds created by the heat activated dry adhesive, as well as for the bonds created when radio frequency welding or ultrasonic welding are used. The bonds must remain intact, and not become brittle after a minimum of at least six (6) washing and drying cycles. Further, they must not allow or permit any of the edges of the plastic bearing the image, which overlies the textile substrate, to become free during any of the washing and drying cycles. Another criteria to be observed is that the pressure sensitive adhesive layer and the heat activated adhesive layer, each of which have a

minimum thickness of about 1 mil and a maximum thickness of about 10 mils, cannot become brittle after a minimum of six wash/dry cycles. There is, however, no upper or maximum number with regard to the number of wash and dry cycles which the textile fabric can withstand or be subjected to without the layers becoming brittle. Additionally, the pressure sensitive adhesive layer should be inert to the inks employed in the image printed on the plastic and, further, the pressure sensitive adhesive layer should also be inert to the plastic layer itself. This latter effect is noted by the absence of crocking (color) in the water during the washing cycles.

Other means of creating a bond between the plastic layer bearing the imprinted image and the fibrous layered article or substrate, which has been adverted to previously, is to use welding to create a bond. For example, FIG. 13 depicts a lenticular plastic layer 1 bearing an image 2 on its back surface, which is welded along its edges or borders 18 by a series of spot welds 19 to fibrous substrate layer 5. Similarly, in FIG. 14 there is shown a non-lenticular plastic layer 11 bearing an image 12 on its back surface, with the image-bearing plastic layer being welded along its edges or borders 18 by a series of spot welds 19 to fibrous substrate layer 15. Either ultrasonic welding or radio frequency welding can be employed, as well as other welding techniques at elevated pressures from about 10 to about 150 psig, with about 80 to about 100 psig preferred. When using these welding

techniques, one can simply melt the image-bearing plastic layer into the fibrous, e.g., textile, layer or substrate. Alternatively, when welding is employed, a heat sensitive adhesive layer can be juxtaposed or inserted between the article having a fibrous layer and the plastic layer bearing the imprinted image. The heat sensitive layer is melted and pressed into the fibrous substrate. Still another alternative when welding is employed is to insert or juxtapose a pressure sensitive layer between the heat sensitive layer and the surface of the image bearing plastic layer. The pressure sensitive layer prevents image distortion by acting to both relieve and distribute stresses, thus allowing for expansion and contraction during the wash/dry/wear cycles. When using welding, only the edges or borders are bonded to the textile. When an adhesive layer or layers are interposed between the plastic layer and the fibrous layer during welding, the two layers are bridged by the heat set adhesive, or by the heat set and pressure sensitive adhesive, when both are used.

Where welding is used, either radio frequency or ultrasonic welding, as the bonding means, the plastic layer must be capable of being melted by electro-mechanical energy and it should melt sharply, i.e., a sharply defined melting point, so a bond-and-cut technique is possible. Further, all bonds must be able to withstand six wash and dry cycles without loss of bond strength and must retain flexibility. Such loss of bond strength is noted by the lifting of the edges of the plastic layer and/or the

pulling of the textile fibers, or the peeling of the textile fibers. Furthermore, no bond should create a leachable by-product. A leachable by-product is one which comes out of the bond and/or discolors the fabric when it is washed and dried.

The process of the present invention namely, printing on lenticular plastic and bonding or joining same to a fibrous layer or substrate by means of specific combination of adhesives, or by welding with or without one or more intermediate adhesives, has applicability with respect to articles of apparel, unique trading or athletic cards, and flexible packaging, promotional and advertising pieces employing three-dimensional images, holograms, stereograms and animated imagery which will serve to catch and hold the eye of the viewer. The foregoing is also true with respect to the preparation of articles of apparel, trading cards, promotional, mailing, and advertising pieces when printing flat, two-dimensional images on non-lenticular plastics in accordance with the present invention.

The following examples will serve to illustrate certain embodiments of the present invention.

Examples 1-5

The materials employed and the results obtained as set forth in Table 1 below represent the sum of multiple experiments employing the indicated constituents of the five (5) listed examples.

Initially, in each of the five (5) examples, sheets of both lenticular and non-lenticular plastic were compounded from a thermoplastic polyurethane resin having either an ether backbone or an ester backbone manufactured by B.F. Goodrich under the registered trademark Estane.

The back surfaces of the lenticular and non-lenticular plastic sheets had images imprinted thereon by offset lithography using U.V. curable lithographic inks. Thereafter, as can be seen by reference to Table 1, either a pressure sensitive adhesive (PSA) and a heat sensitive adhesive (HSA) were applied, as in Examples 1 and 2, or only a pressure sensitive adhesive, as in Examples 3 and 5, or only a heat activated or sensitive adhesive as in Example 4.

In Examples 1 and 2, the adhesive system employed, namely, PH1, which is a trademark of Plastic Associates, Inc. of Roswell, Georgia, is a combination of a rubber modified acrylic (PSA) and a heat activated polyester (HSA).

In Examples 3 and 5 only a PSA was employed, namely, PH1A, which is a trademark of Plastic Associates, Inc. for a rubber modified acrylic.

In Example 4, only an HSA was employed, namely, a heat activated polyester.

Thereafter, in each example the image-bearing Estane sheet, having the particular adhesive bonded thereto, was laminated at 415^{0}F and 80 psi to the fibrous substrate noted in Table 1 below.

After laminating, each of the textiles in Examples 1-5 were washed using either cold or warm water in the wash cycle, following by drying in a dryer at a temperature no greater than 140^0F.

TABLE 1

	Base Plastic	Pressure Sensitive	Heat Activate	Textile	Wash/Dry Cycle
Example 1	Estane (ether backbone)	X	X	Cotton	6 (Pass)
Example 2	Estane (ester backbone)	X	X	Cotton	6 (slight yellowing)
Example 3	Estane (ester or ether backbone)	X		Cotton	1 (piece delaminated)
Example 4	Estane (ester or ether backbone)		X	Cotton	Image delaminated
Example 5	Estane (ester or ether backbone)	X		50/50 blend (Cotton/ Polyester)	6 (Pass)

It can be seen from an examination of Table 1 that after the completion of six (6) wash and dry cycles that the 100% cotton textile article of Example 1, with an image-bearing thermoplastic polyurethane with an ether backbone, bonded with both a pressure sensitive adhesive and a heat activated adhesive, produced the best results by withstanding six (6) wash and dry cycles without delaminating, yellowing, running of the ink, or image distortion.

Examples 6-7

The materials employed and the results obtained as set forth in Table 2 below represent the sum of multiple experiments employing the indicated constituents of the two (2) listed examples.

Initially, in both examples, sheets of both lenticular and non-lenticular plastic were compounded from: (1) a plasticized polyvinyl chloride resin manufactured by Geon Corporation under the registered trademark GEON; and (2) a thermoplastic elastomer, specifically a polyether block amide resin manufactured by Elf Atochem Corp. under the registered trademark PEBAX.

The back surfaces of the lenticular and non-lenticular plastic sheets had images imprinted thereon by offset lithography using U.V. curable lithographic inks. Thereafter, as can be seen by reference to Table 2, a pressure sensitive adhesive and a heat sensitive adhesive were applied in Examples 6 and 7. The adhesive system employed, PH1, is a trademark of Plastic Associates, Inc., of Roswell, Georgia, is a mixture of a rubber modified acrylic pressure sensitive adhesive and a polyester heat activated adhesive.

Thereafter, the image-bearing plastic sheet, having the PH1 adhesive bonded thereto, was laminated at 415^{0}F and 80 psi to the fibrous substrate noted in Table 2 below.

After completing lamination, the textiles in Examples 6-7 were washed using either cold or warm water in the wash

cycle, followed by drying in a dryer at a temperature no greater than 140°F.

TABLE 2

	Base Plastic	Pressure Sensitive	Heat Activate	Textile	Wash/Dry Cycles
Example 5 6	Geon	X	X	Cotton	6 (yellow) (brittleness (loss of lustre)
Example 7	Pebax	X	X	Cotton	6 (Pass)

It can be seen from the results of the wash/dry cycles, that PEBAX, which is a thermoplastic elastomer, which is the preferred plastic for use in accordance with the present invention, produced superior results (see Example 7) by withstanding six (6) wash and dry cycles without yellowing, becoming brittle, or losing lustre. By contrast, the plasticized polyvinyl chloride i.e., Geon, had more yellow and less toughness and lustre after six (6) wash and dry cycles, even though the same pressure sensitive and heat activated adhesives were used in the two (2) examples.

Examples 8-11

The materials employed and the results obtained as set forth in Table 3 below represent the sum of multiple experiments employing the indicated constituents of the four (4) listed examples.

Initially, in each of the four (4) examples, sheets of

both lenticular and non-lenticular plastic were compounded from: (1) an Estane resin as referenced in Examples 1-5; and (2) a Pebax resin as referenced in Example 7.

The back surfaces of the lenticular and non-lenticular plastic sheets had images imprinted thereon by offset lithography using U.V. curable lithographic inks. Thereafter, only a heat activated adhesive was bonded to the plastic sheet. The heat activated adhesive employed in Examples 8-11 was nylon, which is manufactured by Plastic Associates, Inc. of Roswell, Georgia under the trademark PH2B. No pressure sensitive adhesive was employed in Examples 8-11.

Then the image-bearing Estane sheet and the image-bearing Pebax sheet, having the PH2B adhesive bonded thereto, were each laminated by ultrasonic welding and radio frequency welding at a pressure of 80 psi.

TABLE 3

Ex.	Base Plastic	Heat Activ.	Textile	Radio Freq. Weld.	Ultra-sonic Weld.	Wash/ Dry Cycle
8	Estane	X	Cotton	X		6 (Pass)
9	Pebax	X	Cotton		X	6 (Pass)
10	Estane	X	Cotton		X	6 (Pass)
11	Pebax	X	Cotton	X		6 (Pass)

Examples 8-11 demonstrate that both radio frequency welding and ultrasonic welding can be employed in

accordance with the present invention to achieve a lamination between the image-bearing plastic layer and the textile layer which can successfully withstand at least six (6) wash/dry cycles without yellowing, delaminating, becoming brittle, or losing lustre.

It will be appreciated that various changes and modifications of the present invention can be made without departing from its spirit and scope. The various embodiments described herein are intended to illustrate the invention, but are not intended to limit it.

What is claimed is:

1. A method of producing an optical effect selected from the group consisting of three-dimensional images, animated imagery, stereograms and holograms by an image printed on a lenticular plastic layer laminated to an article having a fibrous layer, which comprises:

(a) printing the reverse of the image on the back surface of the lenticular plastic layer;

(b) laminating the lenticular plastic image-bearing layer to a surface of a pressure sensitive adhesive layer with the other surface of said pressure sensitive adhesive layer bonded to a surface of a heat sensitive adhesive layer, while the other surface of the heat sensitive adhesive layer is bonded to the article having a fibrous layer whereby the laminated image gives the appearance of depth and/or motion while preventing distortion of the image.

2. The method of claim 1 wherein the fibrous layer is selected from the group consisting of naturally occurring fibers, synthetic fibers, and a mixture of naturally occurring and synthetic fibers.

3. The method of claim 2 wherein the lenticular plastic is a clear plastic.

4. The method of claim 3 wherein the clear plastic is a thermoplastic elastomer selected from the group consisting of thermoplastic polyurethanes, thermoplastic polyurethanes with an ether backbone, thermoplastic polyurethanes with an ester backbone, olefinic thermoplastic vulcanizates, thermoplastic olefins, styrene block copolymers, copolyesters and copolyamides.

5. The method of claim 4 wherein the thermoplastic elastomer is a thermoplastic polyurethane.

6. The method of claim 5 wherein the thermoplastic polyurethane has an ether or ester linkage in its backbone.

7. The method of claim 6 wherein the thermoplastic polyurethane has a Shore A hardness of between about 70 and about 120.

8. The method of claim 1 wherein the pressure sensitive adhesive is selected from the group consisting of acrylics, polyvinylacetate, polyvinyl alcohol, polyaramids, cellulose nitrate, silicones and rubber modified derivatives of the foregoing.

9. The method of claim 8 wherein the pressure sensitive adhesive is an acrylic.

10. The method of claim 1 wherein the heat sensitive

adhesive is a member selected from the group consisting of nylon, polyester, vinyl and polyurethane adhesives.

11. The method of claim 1 wherein the image is printed on a press selected from the group consisting of a lithographic press, flexographic press and a gravure press.

12. The method of claim 1 wherein the printing inks are selected from the group consisting of waterless inks, ultraviolet inks, and vegetable-oil based inks.

13. The method of claim 1 wherein the laminating is effected at a pressure of from about 10 to about 150 psig, at a temperature of from about 200^{0}F to about 450^{0}F for a period of at least about three seconds.

14. A method of producing an optical effect selected from the group consisting of three-dimensional images, animated imagery, stereograms and holograms by an image printed on a lenticular plastic layer laminated to an article having a fibrous layer, which comprises the steps of:

(a) printing the reverse of the image on the back surface of the lenticular plastic layer;

(b) bonding the lenticular plastic layer to the fibrous layer by welding whereby the lenticular plastic is melt bonded to the article having a

fibrous layer.

15. The method of claim 14 wherein the type of welding is selected from the group consisting of ultrasonic welding and radio-frequency welding.

16. The method of claim 14 and including in step (b) a heat sensitive adhesive layer between the fibrous layer and the surface of the printed lenticular plastic layer.

17. The method of claim 16 and further including in step (b) a pressure sensitive adhesive layer between the heat sensitive adhesive layer and the surface of the printed lenticular plastic layer.

18. An article having a fibrous layer and having an image possessing an optical effect selected from the group consisting of three-dimensional images, animated imagery, stereograms and holograms printed on a lenticular plastic layer laminated thereto, which produces the appearance of depth and/or motion while preventing distortion of the image, which comprises:

(a) the lenticular plastic layer having the reverse of a three-dimensional image, animated image, stereogram or hologram printed on the back surface of the lenticular plastic layer;

(b) said image being bonded to said lenticular

plastic layer by a surface of a pressure sensitive adhesive layer, the other surface of said pressure sensitive adhesive layer being bonded to a surface of a heat sensitive adhesive layer;

(c) the other surface of said heat sensitive adhesive layer being bonded to the article having a fibrous layer to form a laminated article.

19. The article of claim 18 wherein the article having a fibrous layer is selected from the group consisting of naturally occurring fibers, synthetic fibers, and mixtures of naturally occurring and synthetic fibers.

20. The article of claim 18 wherein the article having a fibrous layer is an article of apparel.

21. The article of claim 18 wherein the lenticular plastic is a clear plastic.

22. The article of claim 21 wherein the clear plastic is a thermoplastic elastomer selected from the group consisting of thermoplastic polyurethanes, thermoplastic polyurethanes with an ether backbone, thermoplastic polyurethanes with an ester backbone, olefinic thermoplastic vulcanizates, thermoplastic olefins, styrene block copolymers, copolyesters and copolyamides.

23. The article of claim 22 wherein the thermoplastic elastomer is a thermoplastic polyurethane.

24. The article of claim 23 wherein the thermoplastic polyurethane has an ether or ester linkage in its backbone.

25. The article of claim 24 wherein the thermoplastic polyurethane has a shore A hardness of between about 70 and about 120.

26. The article of claim 18 wherein the pressure sensitive adhesive is selected from the group consisting of acrylics, polyvinylacetate, polyvinyl alcohol, polyaramids, cellulose nitrate, silicones and rubber modified derivatives of the foregoing.

27. The article of claim 26 wherein the pressure sensitive adhesive is an acrylic.

28. The article of claim 18 wherein the heat sensitive adhesive is a member selected from the group consisting of nylon, polyester, vinyl and polyurethane adhesives.

29. The article of claim 18 wherein the image is printed on a press selected from the group consisting of a lithographic press, flexographic press, or a gravure press.

30. The article of claim 18 wherein the printing employs an ink selected from the group consisting of waterless inks, ultraviolet inks and vegetable-oil based inks.

31. An article having a fibrous layer and having an image possessing an optical effect selected from the group consisting of three-dimensional images, animated images, stereograms and holograms printed on a lenticular plastic layer laminated thereto, which produces the appearance of depth and/or motion while preventing distortion of the image, which comprises:

(a) the lenticular plastic layer having the reverse of a three-dimensional image, an animated image, a stereogram, or a hologram printed on the back surface of the lenticular plastic layer;

(b) said lenticular plastic layer melt bonded to the article having the fibrous layer by welding.

32. The article of claim 31 wherein ultrasonic or radio frequency welding is employed.

33. The article of claim 31 wherein the article having the fibrous layer is an article of apparel.

34. The article of claim 31 and including in (b) a layer of a heat sensitive adhesive between the fibrous

layer and the printed lenticular plastic layer.

35. The article of claim 34 and further including in (b) a pressure sensitive adhesive layer between the heat sensitive layer and the printed lenticular plastic layer.

36. A method of producing a two-dimensional image imprinted on a non-lenticular plastic layer sheet, laminated to an article having a fibrous layer, while preventing distortion of the image, which comprises:

(a) printing the reverse of the image on the back surface of the non-lenticular plastic layer;

(b) laminating the printed image directly onto the back surface of the non-lenticular plastic sheet by means of a pressure sensitive adhesive layer with the other surface of said pressure sensitive layer bonded to one surface of a heat sensitive adhesive layer, while the other surface of the heat sensitive adhesive is bonded to the article having a fibrous layer.

37. The method of claim 36 wherein the fibrous layer is selected from the group consisting naturally occurring fibers, synthetic fibers and a mixture of natural and synthetic fibers.

38. The method of claim 36 wherein the non-lenticular

plastic is a clear plastic.

39. The method of claim 38 wherein the clear plastic is a thermoplastic elastomer selected from the group consisting of thermoplastic polyurethanes, thermoplastic polyurethanes with an ether backbone, thermoplastic polyurethanes with a ester backbone, olefinic thermoplastic vulcanizates, thermoplastic olefins, styrene block copolymers, copolyesters and copolyamides.

40. The method of claim 39 wherein the thermoplastic elastomer is a thermoplastic polyurethane.

41. The method of claim 40 wherein the thermoplastic polyurethane has an ether or ester linkage in its backbone.

42. The method of claim 41 wherein the thermoplastic polyurethane has a Shore A hardness of between about 70 and about 120.

43. The method of claim 36 wherein the pressure sensitive adhesive is selected from the group consisting of acrylics, polyvinylacetate, polyvinyl alcohol, polyaramids, cellulose nitrate, silicones and rubber modified derivatives of the foregoing.

44. The method of claim 43 wherein the pressure sensitive adhesive is an acrylic.

45. The method of claim 36 wherein the heat sensitive adhesive is selected from the group consisting of nylon, polyester, vinyl and polyurethane adhesives.

46. The method of claim 36 wherein the image is printed on a press selected from the group consisting of a lithographic press, a flexographic press and a gravure press.

47. The method of claim 36 wherein the printing inks are selected from the group consisting of waterless inks, ultraviolet inks and vegetable-oil based inks.

48. The method of claim 36 wherein the laminating is effected at a pressure of about 10 psig to about 150 psig, at a temperature of about 200^{0}F to about 450^{0}F for a period of at least about three seconds.

49. A method of producing a two-dimensional image printed on a non-lenticular plastic sheet laminated to an article having a fibrous layer while preventing distortion of the image, which comprises the steps of:

(a) printing the reverse of the image on the back surface of the non-lenticular plastic sheet;

(b) bonding the non-lenticular plastic layer to the article having a fibrous layer by welding whereby the non-lenticular plastic is melt-

bonded to the article having a fibrous layer.

50. The method of claim 49 wherein the type of welding is selected from the group consisting of ultrasonic welding and radio frequency welding.

51. The method of claim 49 and including in step (b) a heat sensitive adhesive layer inserted between the article of apparel and the printed non-lenticular plastic sheet.

52. The method of claim 51 and further including in step (b) a pressure sensitive adhesive layer between the heat sensitive adhesive layer and the printed non-lenticular plastic sheet.

53. An article having a fibrous layer and having a two-dimensional image printed on a non-lenticular plastic layer laminated thereto, which comprises:

(a) a non-lenticular plastic layer having the reverse of an image printed on the back surface of the non-lenticular plastic layer;

(b) said image being bonded to said non-lenticular plastic layer by a surface of a pressure sensitive adhesive layer, the other surface of said pressure sensitive adhesive layer being bonded to a surface of a heat sensitive adhesive

layer;

(c) the other surface of said heat sensitive adhesive layer being bonded to the article having a fibrous layer of apparel to form a laminated article.

54. The article of claim 53 wherein the article having a fibrous layer is selected from the group consisting of naturally occurring fibers, synthetic fibers, and mixtures thereof.

55. The article of claim 53 wherein the article having a fibrous layer is an article of apparel.

56. The article of claim 53 wherein the non-lenticular plastic is a clear plastic selected from the group consisting of thermoplastic polyurethanes, thermoplastic polyurethanes with an ether backbone, thermoplastic polyurethanes with an ester backbone, olefinic thermoplastic vulcanizates, thermoplastic olefins, styrene block copolymers, copolyesters and copolyamides.

57. The article of claim 56 wherein the clear plastic is a thermoplastic elastomer.

58. The article of claim 57 wherein the thermoplastic elastomer is a thermoplastic polyurethane.

59. The article of claim 58 wherein the thermoplastic polyurethane has an ether or ester linkage in its backbone.

60. The article of claim 59 wherein the thermoplastic polyurethane has a shore A hardness of between about 70 and about 120.

61. The article of claim 53 wherein the pressure sensitive adhesive is selected from the group consisting of acrylics, polyvinylacetate, polyvinyl alcohol, polyaramids, cellulose nitrate, silicones and rubber modified derivatives of the foregoing.

62. The article of claim 61 wherein the pressure sensitive adhesive is an acrylic.

63. The article of claim 53 wherein the heat sensitive adhesive is a member selected from the group consisting of nylon, polyester, vinyl and polyurethane adhesives.

64. The article of claim 53 wherein the image is printed on a press selected from the group consisting of a lithographic press, flexographic press, or a gravure press.

65. The article of claim 53 wherein the printing employs an ink selected from the group consisting of waterless inks, ultraviolet inks and vegetable-oil based

inks.

66. An article having a fibrous layer and having a two-dimensional image printed on a non-lenticular plastic layer laminated thereto, which comprises:

(a) the non-lenticular plastic layer having an image printed on the back surface of the non-lenticular layer; and

(b) said non-lenticular plastic layer melt bonded to the article having the fibrous layer by welding.

67. The article of claim 66 wherein ultrasonic or radio frequency welding is employed.

68. The article of claim 66 wherein the article having a fibrous layer is an article of apparel.

69. The article of claim 66 and including in (b) a layer of a heat sensitive adhesive layer between the fibrous layer and the printed non-lenticular plastic layer.

70. The article of claim 69 and further including in (b) a pressure sensitive adhesive layer between the heat sensitive layer and the printed non-lenticular plastic layer.

FIG. 1

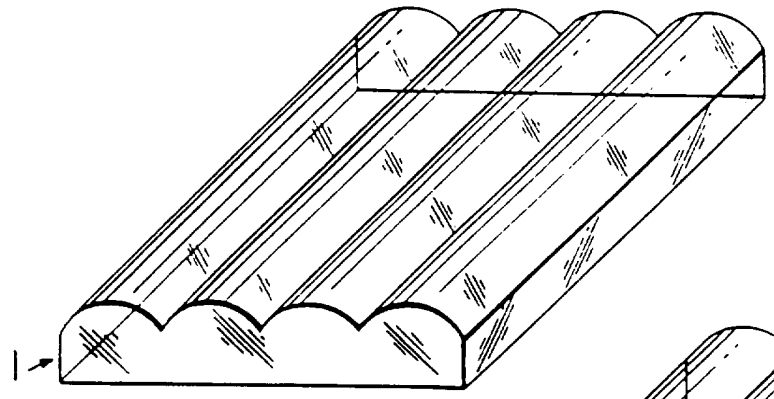


FIG. 2

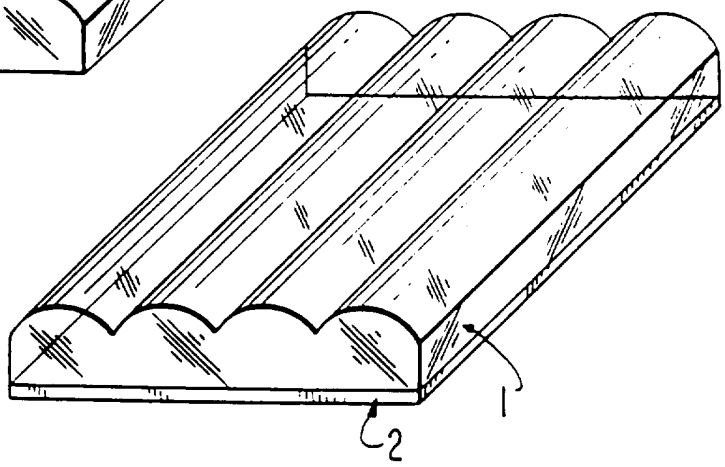


FIG. 3

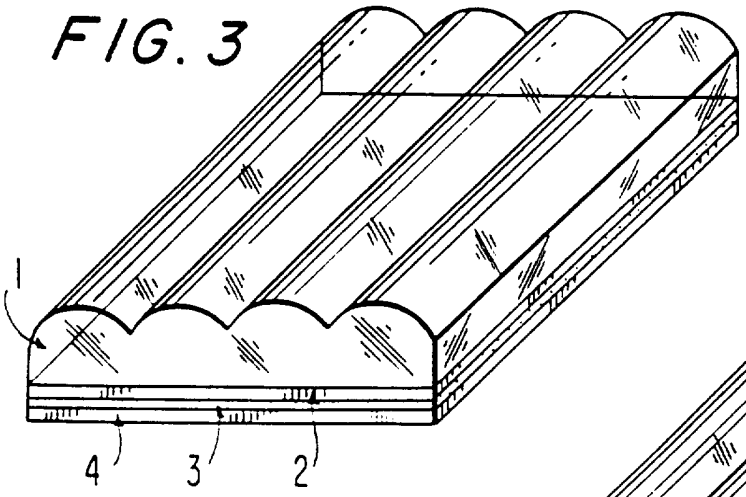


FIG. 4

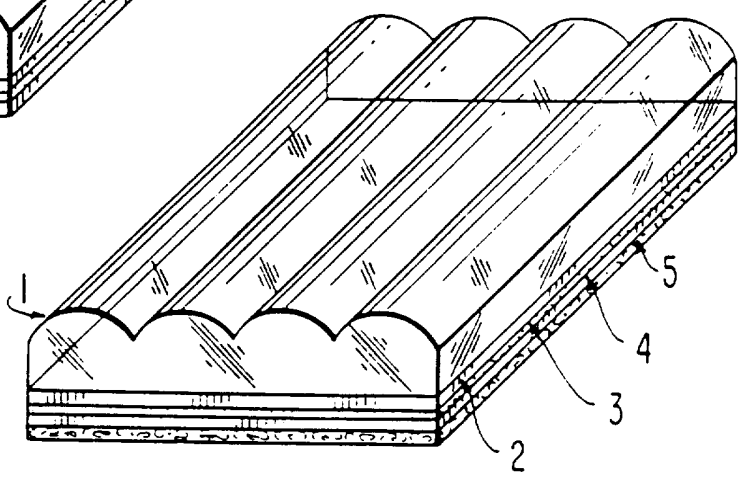


FIG. 5

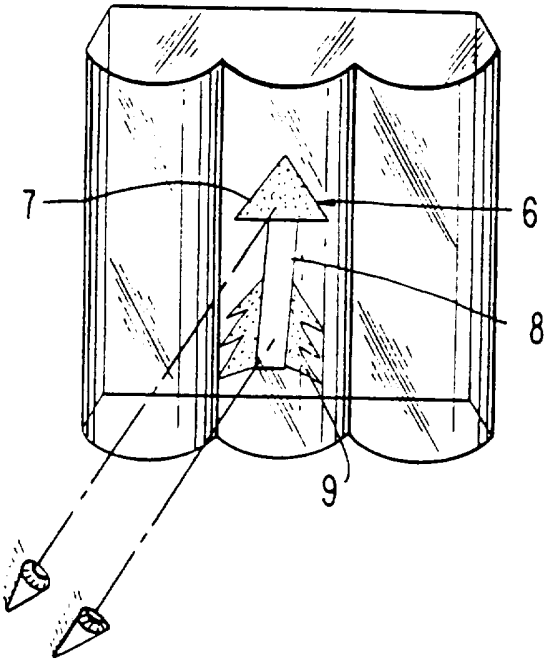
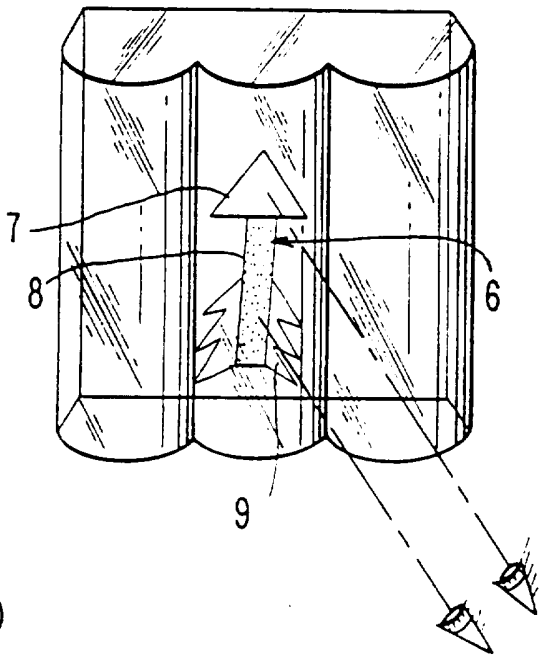


FIG. 6



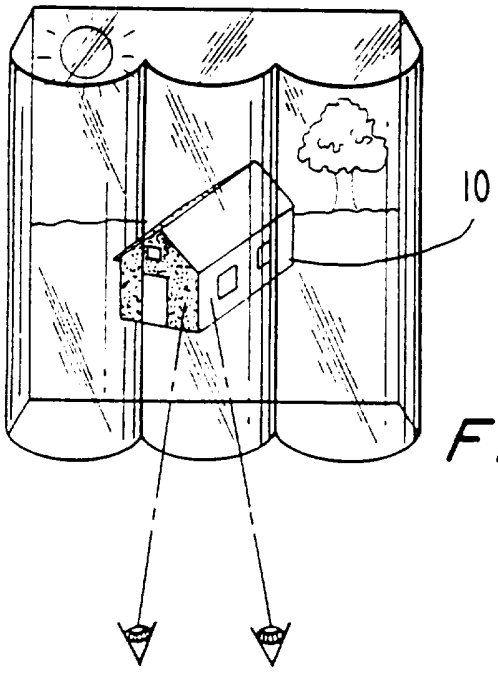


FIG. 7

FIG. 8

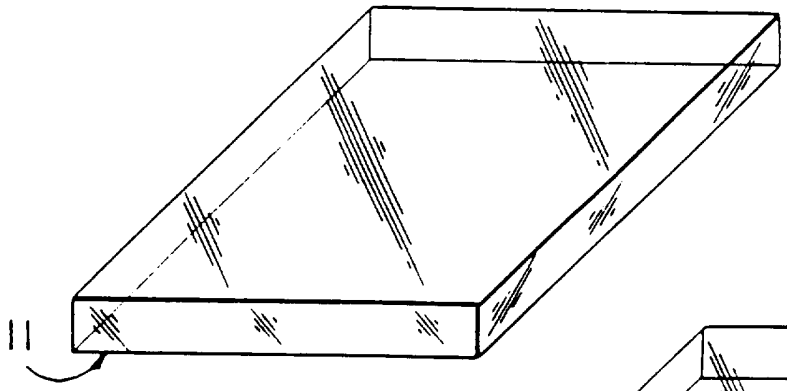


FIG. 9

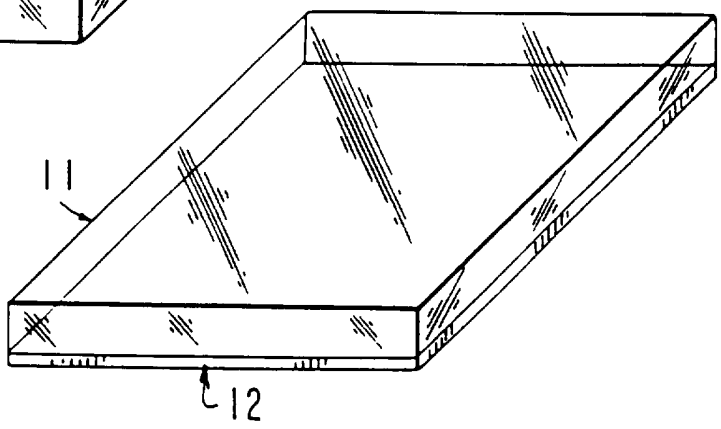


FIG. 10

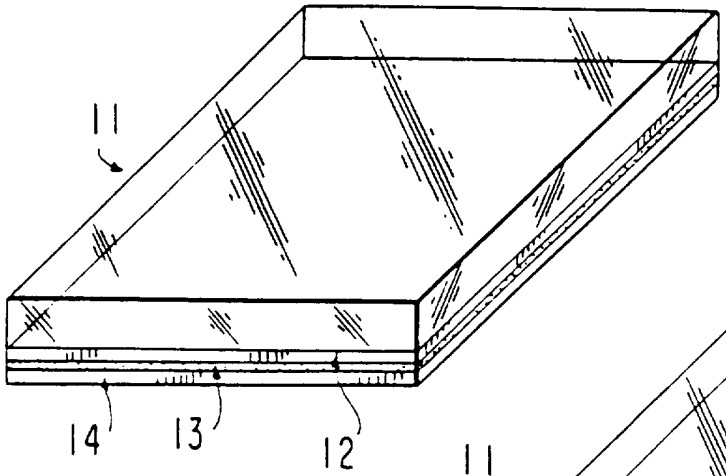


FIG. 11

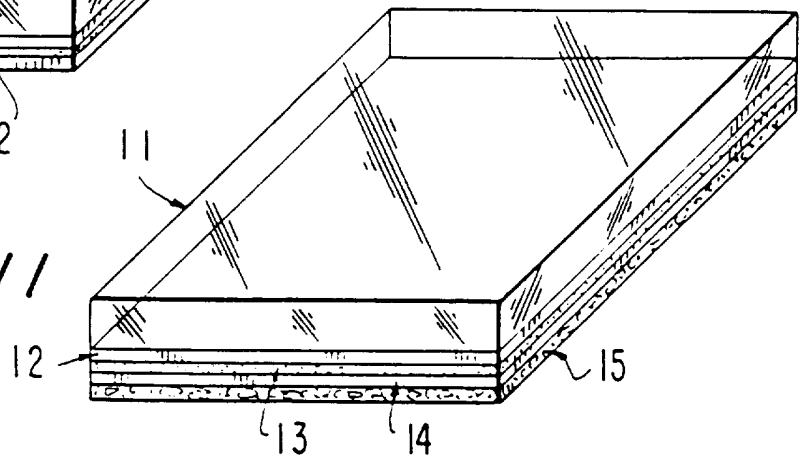
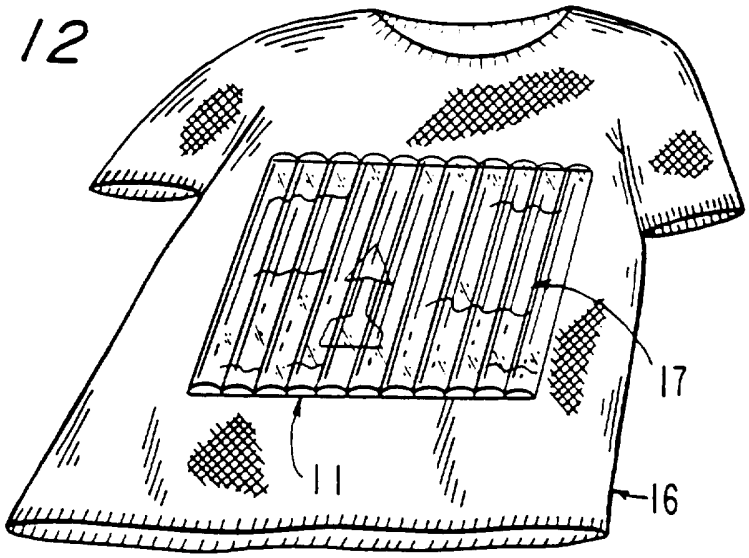


FIG. 12



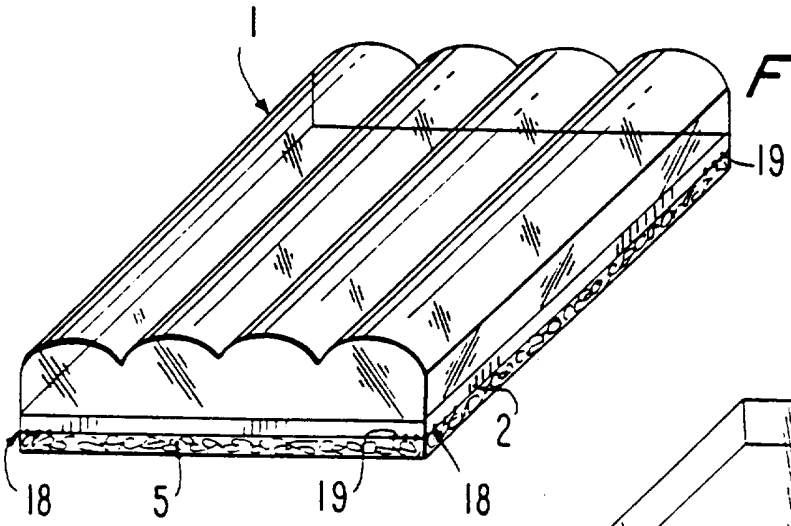


FIG. 13

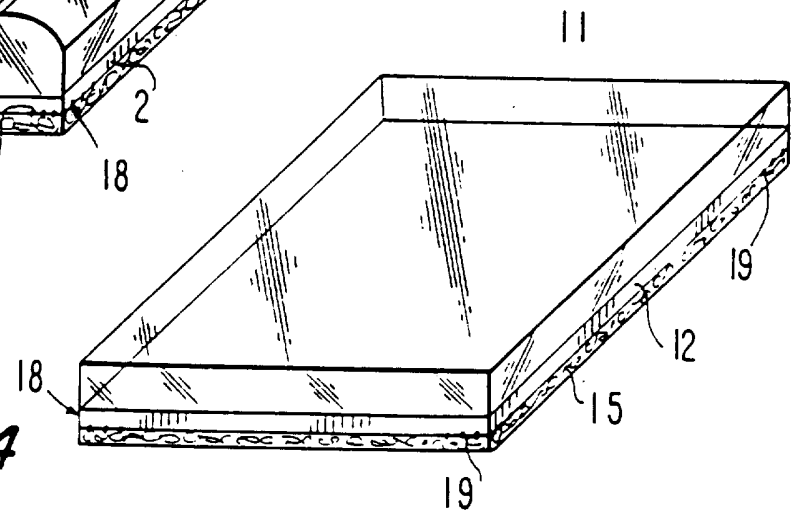


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/02013

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B32B 31/12
US CL : 156/277; 427/208.8; 428/346
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 156/277, 209, 219, 220, 230, 240, 308.2, 309.6; 427/208.8, 208.4, 208.2; 428/346, 200, 198, 203

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE, A, 1,629,298 (WERNER) 20 January 1972, English abstract.	14-16, 31-34
Y	FR, A, 2,521,076 (SCHAFFER) 12 August 1983, English abstract.	14-16, 31-34, 49-51, 66-69
Y	US, A, 4,338,150 (WEEKS) 06 July 1982, col. 3, lines 5-26.	14-16, 31-34, 49-51, 66-69
Y	US, A, 4,490,199 (DUNNING) 25 December 1984, col. 2, line 63 to col. 3, line 9.	14-16, 31-34, 49-51, 66-69
A	US, A, 3,264,164 (JEROTHE ET AL) 02 August 1966.	

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
05 MAY 1996

Date of mailing of the international search report
29 MAY 1996

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer
DAVID A. SIMMONS

Telephone No. (703) 308-1972

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/02013

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 3,257,228 (REED) 21 June 1966.	
A	US, A, 4,838,965 (BUSSARD) 13 June 1989.	
A	US, A, 4,856,857 (TAKEUCHI ET AL) 15 August 1989.	
A	US, A, 3,146,492 (LEMELSON) 01 September 1964.	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/02013

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/02013

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains claims directed to more than one species of the generic invention. These species are deemed to lack Unity of Invention because they are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for more than one species to be examined, the appropriate additional examination fees must be paid. The species are as follows:

I. Fig. 3.

II. Fig. 13.

III. Fig. 11.

IV. Fig. 14

The claims are deemed to correspond to the species listed above in the following manner:

I. Claims 1-13, drawn to a method, and claims 18-30, drawn to an article, all involving lenticular plastic and not involving welding.

II. Claims 14-17, drawn to a method, and claims 31-35, drawn to an article, all involving non-lenticular plastic and welding.

III. Claims 36-48, drawn to a method, and claims 53-65, drawn to an article, all involving non-lenticular plastic and not involving welding.

IV. Claims 49-52, drawn to a method, and claims 66-70, drawn to an article, all involving non-lenticular plastic and welding.

The following claims are generic: NONE

The species listed above do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, the species lack the same or corresponding special technical features for the following reasons: The claims involve either lenticular or non-lenticular plastic, and either do or do not involve welding.