INJECTION MOLDED PREFORM WITH IMPRINTED SURFACE FEATURE

A hollow plastic preform (1) suitable for blow molding a plastic container (3) having a shaped design (11) on its outer and/or inner surface is formed. The preform (1) is injection molded and a shaped feature (5) is imprinted or molded into the inner surface and/or outer surface of the preform. The shaped feature (5) is sized, shaped, and oriented on the preform (1) to, upon blow molding, produce the shaped design (11) on the outer and/or inner surface of the blow molded container (3).
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INJECTION MOLDED PREFORM WITH IMPRINTED SURFACE FEATURE

Field of the Invention

The present invention pertains to a process for producing a blow molded plastic container having a shaped and/or colored design feature on the inner and/or outer surface thereof. In particular, this invention pertains to a process of imprinting a shaped design feature and/or colorant into the inner and/or outer surface of a plastic preform suitable for blow molding a plastic container, a preform having such a design feature and/or colorant imprinted in the inner and/or outer surface thereof and a plastic container having a shaped and/or colored design feature on the inner and/or outer surface thereof produced from such a preform.

Background of the Invention

The soft drink industry is a highly competitive industry that has long demanded an inexpensive bottle for packaging its products. Blow molded plastic bottles presently provide the best available combination of structural integrity and economy of manufacture in the industry, and therefore dominate today’s soft drink market. These plastic bottles are typically one piece self-standing bi-axially oriented two liter bottles formed of a tough, flexible plastic, usually a polyester such as PET. The structure of blow molded PET bottles and the process of blow molding PET bottles are well known in the industry and are therefore not described in detail herein.

The highly competitive nature of the soft drink industry demands that bottles provide brand distinction. Changing labels on the generically shaped PET bottles is
simply not enough for today's soft drink market. Labels, while colorful and informative (product information, etc.), are costly to purchase, inventory and apply. In addition, labels are generally "flat" or two dimensional in appearance and do not add to the structural appearance or design of the bottle.

To increase brand distinction, Coca-Cola® has gone to a contoured blow molded PET bottle design with ribbing. While Pepsi Cola® has resorted to swirls on the shoulder, and 7-Up® uses green colored bottles. Other brands likewise desire distinguishing features to identifying their brand or make their bottles stand out among the competition's bottles. Unfortunately, the cost of making selected tooling for each blow molded PET bottle shape, manufacturing and inventory becomes prohibitively expensive. Further, additional material is required to maintain the required structural integrity of a conventional modified PET container when subjected to internal pressurization from the carbonated beverage contained in therein.

Decorative design features are presently molded into PET bottles during the blow molding process, i.e. the structural design of the bottles is shaped by specially designed blow molds. Design features that have been blow molded into the bottles may frequently have an adverse effect on the structural integrity and strength of the bottles. When a blow molded bottle is filled with a carbonated beverage, the plastic walls tend to yield (creep) due to the internal pressurization of the container, particularly in areas that are weakened by a conventionally blow molded design. The yielding of the bottle upon carbonation causes the design features that have been costly blow molded into the container to become diminished and/or distorted. Extra material is required
in the area of the design to provide added wall strength and prevent diminution and distortion of the blow molded design features.

At a market price for PET material of U.S. $0.75/pound ($1.65/kg), one additional gram of resin per bottle adds $0.00165 to the cost of manufacturing each bottle. If that cost is spread over 5 billion bottles then the increased cost will be more than $8,000,000 per year. Each additional gram of PET per bottle would add $8 million to annual costs.

It is an object of the present invention to provide a flexible inexpensive process of producing blow molded plastic containers having shaped decorative and/or design features.

It is a further object of the invention to provide a process that reduces the quantity of material required to form a shaped decorative or design feature on a blow molded plastic container, while maintaining the structural integrity of the container.

**Summary of the Invention**

The objects of the present invention are achieved by imprinting shaped a design feature onto the inner and/or outer surface of a preform suitable for blow molding a container.

According to the invention there is provided a process of producing a hollow plastic preform suitable for blow molding a plastic container having a shaped design on at least one of an outer and inner surface of the container, comprising the steps of: a) injection molding a hollow plastic preform suitable for blow molding a plastic container; and b) forming (molding or imprinting) a shaped feature into at least one of an inner surface and an outer surface of the preform, the shaped feature being
sized, shaped and oriented on the preform to, upon blow molding the preform into a container, produce the shaped design on the at least one of an outer and inner surface of the container.

According to the invention there is also provided a hollow plastic preform suitable for blow molding a plastic container having a shaped design on at least one of an outer and inner surface of the container produced by the above process, and a container blow molded from such a preform.

According to the invention there is also provided a process of blow molding a plastic container having design features on at least one of an inner and an outer surface of the container from a preform produced according to the above process.

**Brief Description of the Drawings**

The invention will now be described, by way of example, with reference to the accompanying Figures, in which:

Fig. 1 is a simplified cross-sectional view of an injection molded plastic preform that has been imprinted with shaped design features according to the present invention, along with a bottle having shaped design features produced from such an imprinted preform, in which the thickness of the walls of the preform and container and the depth of the imprinted design features have been exaggerated for illustration purposes; and

Fig. 2 is diagrammatic illustration of a preform having a design feature imprinted an a surface thereof along with a container blow molded from such a preform, showing the degree of stretch of the design.
Detailed Description of the Preferred Embodiments

Referring now to the Figure 1, the surface of an injection molded plastic, for example, PET, preform 1, suitable for blow molding into a plastic container 3, is imprinted with shaped design features 5, such as swirls, ridges, ribs, designs and/or textured areas in a recessed panel 7, for example, by pressing a branding iron into the inner and/or outer surface of the preform 1. The branding iron is contoured radially and longitudinally to the surface of the preform 1 to be imprinted and the surface of the branding iron is a relief of the shaped features 5 to be imprinted on the preform. The branding iron may have surfaces at two or more levels for imprinting design features 5 of different depths in a single imprinting step.

To imprint the design features 5 into the preform 1, the branding iron is heated to a temperature of about 300°F to about 330°F and is pressed against the surface of the preform to be imprinted for 1/4 to 3 seconds at a sufficient pressure to form the shaped features 5. The amount of time and pressure required to imprint the design features 5 into the surface of the preform depend upon the area, contour, depth, etc. of the design features 5.

The design features 5 are imprinted to a depth of 0.0005 inches (0.0127 mm) to 0.050 inches (1.27 mm) into the surface of the side wall 9 of a typical preform 1 having a wall thickness in the range of from about 0.135 inches (3.429 mm) to about 0.165 inches (4.191 mm). With this construction, the shaped design features 5 are relatively shallow, compared to the thickness of the side wall 9 of the preform.

When the preform 1 is blow molded into a container 3, the walls 9 of the preform 1 are stretched and thinned by
a factor of up to 15x, thereby producing a container 3 having a typical wall thickness of approximately 0.008 inches (0.203 mm) to 0.015 inches (0.381 mm). The design features 5 are stretched and thinned along with the wall 9 of the preform 1 during blow molding, as shown with dashed lines in Fig. 2. The design features 11 in the resulting container 3 are therefore relatively shallow, compared to the thickness of the wall 13 of the container 3, and do not extend into the inner region of the wall 13. As a result of the relatively shallow depth of the design features 11, the design features 11 according to the invention do not significantly adversely affect the structural integrity of the container 3. Only the surface of the blow molded container 3 is affected by the imprinted design features. No additional material is required to prevent the design features 11 according to the present invention from diminishing or distorting upon internal pressurization of the container 3. Thus, a reduction in material is achieved compared to existing methods of producing design features on blow molded containers.

When blow molded into a container 3, the design features 5 imprinted on the preform will increase in size by a factor of 2-13x, depending on stretch ratios and location of the design features 5 on the resulting blow molded container 3. The location, size, shape and configuration of the design features 5 to be imprinted on the preform 1 must therefore be designed to accommodate the stretch ratios and location of the desired design features 13 on the resulting blow molded container 3.

The shaped design features 5, 11 can be provided on the outer surface 15, 17 only of the preform 1 and resulting container 3, inner surface 19, 21 only, or a combination of both the outer 15, 17 and inner 19, 21
surfaces. Imprinting the design features 5 on the inner surface 19 of the preform 1 will provide the illusion of depth to the design 11 in the resulting container 3. The illusion of depth of the design 11 in the resulting container 3 can be enhanced by imprinting both the outer 15 and inner 19 surfaces of the preform 1. Providing an offset, as illustrated in the figure, between the outer and inner design features 5 further enhances the perception of depth of the design 11 in the resulting container 3 while maximizing retention of wall strength in the resulting container. Moreover, the container 3 can be provided with a tactile feel by placing a design feature 5 on the outer surface 15 of the preform 1, so that the design 11 on the outer surface 17 of the resulting container 3 retains a surface texture shaped design feature 5,13 may be located anywhere on the preform land resulting container 3 as desired, i.e. on the sidewall, base, feet and/or neck portions, for example.

Portions of the surface of the container 3, the design features 11, and/or recessed panel 23 on the container 3 may be colored by embedding a colorant into the outer 15 and/or inner 19 surface of the preform with the branding iron during the imprinting step. The colorant is a concentrated colorant, such as a master batch additive at the same concentration that is conventionally used when coloring an entire preform to producing a colored container.

In order to embed colorant in the surface of the preform 1, the hot branding iron is dipped into beads of colorant, such that the beads of colorant melt and adhere to the branding iron before imprinting the shaped design features 5 into the preform. The melted colorant then becomes embedded in the surface of the preform during the subsequent imprinting step. In this manner, the surface
of the preform is imprinted with the shaped design features with colorant embedded therein in a single imprinting step for producing colored features and shaped features 11 on the resulting container 3. During blow molding, the area of the colored feature may be increased by a factor of about 10x thereby reducing its thickness by a factor of about 10x.

The colorant may be adhered to the branding iron only on a surface of the branding iron that forms a shaped design feature on the preform 1, for coloring at least a portion of a shaped design feature 11 on the container 3. Moreover, different colored colorants may be adhered to different portions and/or different levels of the branding iron and embedded into different areas of the preform 1, for producing differently colored features, differently colored shaped features 11 or any desired combination of colored features and colored shaped features 11 on the surface of the container 3.

Portions of the surface of the container 3 that are blown, i.e. stretched, such as recessed panel 23, for example, can be lightly crystallized, turning these portions slightly white to the eye. By appropriately locating crystallized portions on the container 3, the aesthetics of the design or the container 3 can be enhanced by including clear and white portions as part of the design. In order to form white crystallized portions on the resulting container 3, small localized areas on the outer 17 and/or inner 21 surface of the preform 1 that are to be blown and stretched during blow molding are heated to initiate, but not complete, the desired crystallization, forming crystal initiating sites 25. Due to the relatively small localized nature of crystal initiating sites 25 on the surface of the preform, the preform looks transparent to the naked eye.
Upon subsequent heating and blow molding of the preform 1, the crystal initiating sites 25 cause areas of the surface of the container 3 to crystallize to a depth of 0.0005 inches (0.0127 mm) to 0.005 inches (0.127 mm). The crystallization may, however, extend entirely through the wall of the container 3.

By appropriately locating the crystal initiating sites 25 on the preform 1 in relation to an imprinted design feature, in this case the recessed panel 7, for example, a white design feature, for example, a snowman, star 11 (Fig. 2) or, a white recessed panel 23 (Fig. 1), can be produced on the surface of the resulting container 3. Portions or all of the shaped design features 11 on the container 3 may be made white by appropriately locating the crystal initiating sites 25 on the surface of the preform 1.

Upon being crystallized, the crystallized portions of the wall 13 of the container 3 become more rigid than the uncrystallized portions of the container 3. Less material is therefore required to provide a crystallized design feature with the required strength to prevent distortion of the design feature upon internal pressurization of the container, providing further reductions in material.

In continuing physical tests of bottles having shaped design features produces according to the present invention containing four volumes of carbonation at 100°F, the design features on the bottles have insignificant distortion with pressure or temperature over a period of approximately 168 hours.

Branding with a branding iron, as previously disclosed, is the preferred method for imprinting the shaped design features 5 into the preform 1. However, any suitable method may be employed to imprint the design features into the surface(s) of the preform. The design
features may be imprinted, for example, by cold pressing, hot branding, embossing, etching or laser cutting the features into the surface(s) of the preform, or by any combination of such methods. The method of imprinting a design that covers the entire circumference of the interior and/or exterior surfaces of the preform can be accomplished in several ways. The preform may be rotated 360° while being imprinted by a stationary device, for example, or the imprinting device may orbit 360° around a stationary preform. Also the preform may be appropriately temperature conditioned to facilitate the imprinting.

The term "imprinting", as used throughout the specification and claims, is intended to include any suitable method for forming a shaped design feature in the inner and/or outer surface of a preform suitable for blow molding a container.

The present invention provides a process of producing decorative blow molded containers having design features that alter the geometry of the inner and/or outer surface of a blow molded container without detrimentally effecting the structural integrity of the container. Since design features produced by the present invention do not effect the structural integrity of the container, there is no need to provided additional material to strengthen the container in the area of the design feature. Thus, the present invention reduces the amount of material required to produce blow molded containers having shaped design features on the inner and/or outer surfaces thereof, compared to conventional methods of blow molding such features into the surface of a container. In fact, by the use of suitably shaped imprint patterns, container produced by the present invention may have enhanced strength without any associated weight increase.
While the preferred example of the invention has been described with reference to the imprinting of a pattern into an already molded preform, it will be appreciated that in an alternative embodiment, the pattern may be injection molded into the preform by the use of features formed in the cavity wall of the injection mold used to mold the preform. In such an alternative embodiment the features must be located and designed to permit removal of the preform from the cavity, for example, by locating the features in that portion of the outer wall of the cavity in which the shoulder forming portion and/or sidewall forming portion of the preform are molded. These are portions of the preform in which a wall thickness reduction of at least three and preferably greater than five takes place during blow molding of the preform to form the container with the pattern features therein.

While the pattern will generally, and most conveniently, be formed in the outer surface of the preform, the use of pattern forming features on the surface of the core of the mold is also possible with the pattern then being formed on the inner surface of the preform. As with the imprinting process, a pattern may be formed on both the inner and outer walls of the preform so long as removal of the preform from the mold is facilitated.
In the Claims

1. A process of producing a hollow plastic preform suitable for blow molding a plastic container having a desired shaped design on at least one of an outer and inner surface of the container, comprising the steps of:
   a) injection molding a hollow plastic preform suitable for blow molding a plastic container; and
   b) forming a shaped feature into at least one of an inner surface and an outer surface of the preform, the shaped feature being sized, shaped and oriented on the preform to, upon blow molding the preform into a container, produce the desired shaped design on the at least one of an outer and inner surface of the container.

2. A process according to claim 1, wherein step b) comprises imprinting the shaped feature into the surface of the preform to a depth such that, upon blow molding the imprinted preform into a container, the shaped design in the container has an insignificant affect on structural integrity of the container, for example, wherein step a) comprises injection molding the hollow preform with a sidewall having a thickness from about 0.135 inches (3.429 mm) to about 0.165 inches (4.191 mm); and step b) comprises imprinting the shaped feature into the surface of the preform to a depth of 0.0005 inches (0.0127 mm) to 0.050 inches (1.27 mm).

3. A process according to claim 1 or 2, wherein step b) comprises imprinting a shaped feature into both the inner and outer surfaces of the preform with the shaped feature imprinted into the outer surface of the preform being offset relative the shaped feature imprinted in the inner surface of the preform to, upon blow molding the imprinted preform into a container, further enhance the appearance of depth of design.
4. A process according to claim 1, 2 or 3, wherein the step b) further comprises imprinting a design feature into the outer surface of the preform to, upon blow molding the imprinted preform into a container, provide the outer surface of the container with a tactile, textured feel.

5. A process according to claim 1, 3 or 4, further comprising the step of forming a crystal initiating site on at least one of the inner and the outer surface of the preform, and causing an associated portion of the surface of the container to crystalize, turning the portion white, for example, wherein step a) comprises injection molding the hollow preform with a sidewall having a thickness from about 0.135 inches (3.429 mm) to about 0.165 inches (4.191 mm); and the step of forming a crystal initiating site, upon blow molding the preform into a container, causes the portion of the surface of the container to crystalize to a depth of about 0.0005 inches (0.0127 mm) to about 0.005 inches (0.127 mm).

6. A process according to any preceding claim, further comprising embedding a colorant into one of the inner and outer surface of the preform during the imprinting step, whereby, upon blow molding the imprinted preform into a container, a desired portion of the container is colored forming a colored design on one of the inner and outer surface of the container, for example, wherein the step of imprinting comprises pressing a branding iron into one of the inner and outer surface of the preform at a sufficient temperature and pressure and for a sufficient duration to form the desired shaped feature; and
the step of embedding a colorant comprises
dipping the branding iron into colorant in the form of
beads such that the colorant melts and adheres to desired
portions of the branding iron, prior to the imprinting
step, whereby the colorant adhered to the branding iron
becomes embedded in the surface of the preform during the
imprinting step.

7. A process according to any preceding claim,
wherein step b) comprises imprinting the shaped feature
into the surface of the preform with a branding iron to a
depth such that, upon blow molding the imprinted preform
into a container, the shaped design in the container has
an insignificant affect on structural integrity of the
container.

8. A process of producing a blow molded plastic
container having a desired shaped design on at least one
of an outer and inner surface of the container, comprising
the steps of:

a) injection molding a hollow plastic preform
suitable for blow molding a plastic container;

b) forming a shaped feature into at least one
of an inner surface and an outer surface of the preform,
the shaped feature being sized, shaped and oriented on the
preform to, upon blow molding the preform into a
container, produce the desired shaped design on the at
least one of an outer and inner surface of the container;
and

c) blow molding the preform into a container
having the desired shaped design on the at least one of an
outer and inner surface of the container.

9. A process according to claim 8 wherein the
shaped feature is formed in a portion of the preform which
during blow molding will be subject to a wall thickness
reduction of at least three, preferably at least five.
10. A process according to any preceding claim wherein the shaped feature is produced by branding, cold pressing, embossing, molding, etching and/or, preferably, by laser cutting.

11. A blow molded plastic container having a shaped design on at least one of an outer and inner surface of the container produced by a process according to any preceding claim.

12. A hollow plastic preform suitable for blow molding a plastic container having a shaped design on at least one of an outer and inner surface of the container, produced by a process comprising the steps of:
   a) injection molding a hollow plastic preform suitable for blow molding a plastic container; and
   b) forming a shaped feature into at least one of an inner surface and an outer surface of the preform, the shaped feature being sized, shaped and oriented on the preform to, upon blow molding the preform into a container, produce the desired shaped design on the at least one of an outer and inner surface of the container.
A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) : B29D 22/00; B29C 45/00; B29C 49/06; B29C 59/02, 59/16
US CL : Please See Extra Sheet.
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. : 428/36.92, 542.8; 215/382, 383; 220/674, 675; 264/293, 328.1, 400, 509, 521, 531, 907

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 4,233,262 A (CURTO) 11 November 1980, Figures 1 and 8, col. 3, lines 43-49.</td>
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<td>US 4,339,409 A (CURTO) 13 July 1982, Figures 1 and 8, col. 4, lines 9-14.</td>
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<td>US 4,320,083 A (JAKOBSEN) 16, March 1982, Figures 1 and 4</td>
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☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

Date of the actual completion of the international search
07 MARCH 1997

Date of mailing of the international search report
26 MAR 1997

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Form PCT/ISA/210 (second sheet)(July 1992)*
A. CLASSIFICATION OF SUBJECT MATTER:
US CL:
428/36.92, 542.8, 215/382, 383; 220/674, 675; 264/293, 328.1, 400, 509, 521, 531, 907
INTERNATIONAL SEARCH REPORT

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.: 4-7, 10, AND 11 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:

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.

Form PCT/ISA/210 (continuation of first sheet)(1)(July 1992)*