

Container Closures

Background of the Invention

The present invention relates to closure technology for plastics or plastics coated containers. It is applicable to plastics bottles and steel containers which have a plastics coating or containers made of composite materials with a sandwich construction having plastics surfaces with paper and EVOH or aluminium layers glued together between the plastics surfaces.

The invention is particularly applicable to carbonated and non-carbonated, pasteurised, aseptic or hot-fill products and more specifically to a process for assembling a plastics spout to such a container. The predominant plastics material for gas-tight and heat-resist plastics bottles suitable for this purpose is PET (polyethylene terephthalate).

PET bottles cannot be used for sterilisation by retorting or autoclaving as is used for cans, glass bottles and some high heat resistant plastics such as polypropylene, as they cannot withstand the long exposure to temperatures of the order of 120°C that are involved.

However sterile packaging in such plastics bottles can be achieved by an aseptic process or by hot filling.

In aseptic filling a UHT process is used to process the product prior to filling. The product is subjected to high temperature (140°C) for a very short period (4 seconds) and then cooled to a temperature between ambient and 4 degrees C. Once cooled the product must remain in sterile conditions and cannot be exposed to environmental air or bacteria. The bottles and caps must also be cleaned and sterilised, typically using Hydrogen Peroxide or Paracetic acid, which is evaporated off the components. The bottles are then filled and sealed in an aseptic environment. The packaging must also be sealed tightly enough to prevent re-infection. While this process is effective to provide long shelf-life products and can be used with PET bottles the cost of the filling plant is significant.

PET bottles are also used in hot filling processes in which the product is at a temperature of typically in excess of 85°C as it enters the bottle. In this process the bottles must be clean but not necessarily sterile as any bacteria present will be killed by the hot product. Hot fill processes are more economic but their applications are
5 restricted by the limited heat resistance of PET, which suffers distortion at temperatures over 75°C. Greater than normal heat resistance can be obtained by crystallizing a neck of the bottle, but this increases the cost of the packaging.

A further technical problem is encountered when PET bottles are used in hot filling because a partial vacuum is created inside the bottle after it has been sealed as the
10 product cools. This makes it necessary to develop constructions that prevent collapsing of the container. Examples of such structures are described in WO0113407 and WO0112531 in the name of Graham Packaging Company L P.

An injection stretch blow- moulded PET bottle will normally be sealed by means of an injection moulded cap which engages with features injection moulded on a neck of
15 a preform prior to stretch blow-moulding into a bottle. This will result in good sealing characteristics if the neck remains as originally moulded but begins to fail if there is distortion during the hot filling process. Since a tight seal is essential to prevent re-infection this limits the scope for using PET bottles in the more economical hot filling process although this problem can be overcome by the use of a neck containing more
20 material or by crystallization. These solutions increase the cost of the packaging. The present invention aims to solve this technical problem by the use of alternative closure technology.

An injection moulded spout with a cap has been described in applicants WO 99/61337 (= GB 2337740). This type of closure technology has been applied to extrusion blow
25 moulded bottles where the bottle body and the spout and cap could be made of the same material, typically high density polyethylene (HDPE). Such a material has a typical melting point of 140°C. In this closure technology the bottle and spout are sealed together by means of an intervening plastics coated foil which is welded to both surfaces only at the top face of the neck portion; no weld forming to the side wall. The

spout and cap assembly is applied to a bottle body after filling and would therefore not be affected by the passage of the hot filled product during hot filling. Technical problems are encountered if such a closure assembly is applied to a PET bottle.

5 The first technical problem relates to the distortion of a pourer part of the spout when it is subjected to temperatures sufficient to weld the foil to PET, which only melts at 220°C although some distortion will occur at lower temperatures. It is not practicable to make the spout from PET as this material is too brittle for injection moulding a component of this type.

10 A second technical problem of low weld strength arises if lower temperatures are used to produce the weld between the plastics coated foil and the PET bottle. This may result in a weld which is not strong enough to hold in the pressure of a carbonated product. If the weld joining the spout to the bottle body is weak it may be possible to remove the spout at this junction by applying a lever under a skirt of the spout and using a transport ring of the bottle as a pivot support. This undermines the use of the
15 foil to provide tamper evidence.

Prior art proposals such as described in GB-A- 2108464 (Container Corporation of America) and US 4815618 (Gach) suggest welding a foil onto an upper flat top surface of a container. Unfortunately, this proposal would create a third technical problem if used with PET containers because of the weakness of the weld strength as
20 described above.

Solution of the Invention

The present invention provides a process for assembling a plastics spout to a neck portion defined by a side wall substantially perpendicular to a plane of aligned openings in the neck portion and spout, the side wall being made of or coated with a
25 first plastics material, wherein the spout contains a foil that closes the opening in the spout, the foil having an exposed face coated with a second plastics material compatible with the first plastics material, the process comprising the steps of placing the spout on the neck portion and welding a portion of the exposed face of the foil to

the first plastics material of the side wall.

By welding to a side wall which, in the case of a standard cylindrical neck portion in normal orientation would be vertical, the weld is subjected to a sheer force when a ring pull secured to the foil is used to tear the foil using a force directed along the vertical axis of the neck portion. This contrasts to the tension force which is produced between a weld between the foil and a top horizontal face of the neck portion as suggested by Container Corporation and used in the construction of earlier closures for extruded blow moulded bottles. The process of the present invention does not preclude the creation of a weld between the exposed face of the foil and such a horizontal face of the neck portion above the side wall.

The presence of the vertical weld is also important if any attempt is made to lever off the spout as this also creates a sheer force on this vertical weld. Therefore, this closure technology provides additional security as any removal of the spout would, if successful, result in evident damage to the spout and neck portion.

The solution to the present invention is particularly advantageous when the first plastics material is PET as there is a significantly improved relative strength of a PET weld in sheer rather than in tension.

Preferably the neck portion is an integral part of a container. However in the case of cans, the neck portion may be formed as part of a can end. The can end with spout attached is sealed to the can after the can has been filled.

Typically PET containers are manufactured from injection moulded preforms which are subsequently stretch blow moulded to the required shape. Because the PET bottles are typically used with screw caps, a neck of the preform is moulded with integral screw threads to engage with the cap. The presence of these formations on the neck requires a more complex mould and a significant amount of material. A considerable portion of the cost and weight of a PET bottle is represented by the need to create a complex neck structure to engage with the screw cap.

It will be appreciated that the foil sealed spout as described in WO 99/61337 referred

to above does not require the use of any specific formation on a neck of the bottle body itself and therefore the use of this type of closure instead of the conventional screw cap has the advantage that a much simpler preform having a completely smooth neck can be used. This would eliminate the need for side splits in an upper
5 part of an injection mould as would be required for moulding screw threads. Less material can also be employed. A smooth neck is also easier to keep sterile and to clean. Simpler preforms can also be produced more reliably.

Although it has been proposed to wrap a conduction foil, which is plastics coated on a lower side only, round a side wall of a bottle, it has hitherto always been the case that
10 welds have been made between the foil and a horizontal upper surface of the bottle neck that is easily accessible to a heated iron. Conduction foil capsules have also been provided with side walls to give the foil some structural stability during the assembly process before they are placed on a bottle. A secondary over-cap is then often used to overlie the conduction foil. This type of closure technology does not provide a good
15 resealing capability once the foil has been removed whereas the closure technology of WO 99/61337 (Spreckelsen McGeough Ltd) provides an excellent resealing capability. It is also not practicable to use double sided conduction foils to seal to both containers and spout as a heated iron cannot be applied to a plastics coated foil surface.

20 Preferably the spout provides a supporting structure to hold the portion of the exposed face of the foil needed to weld to the side wall in the appropriate position and this makes it easier to seal containers using this closure technology as the spout and cap assembly can be perched onto the neck portion prior to the formation of the side weld.

The present invention also provides a container having a side wall made of or coated
25 with a first plastics material, a foil welded to an inner or outer surface of the side wall by means of a coating of plastics material compatible with the first plastics material, the foil extending across an opening defined by the neck and being sealed to a closure for the container.

Brief Description of the Drawings

In order that the invention may be well understood an embodiment thereof will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, in which:

- 5 Figure 1A shows a cross section through a first PET preform suitable for use in the present invention;
- Figure 1B shows a detail of a top portion of the preform of Figure 1A
- Figure 1C shows a cross section through a second PET preform suitable for use in the present invention;
- 10 Figure 1D shows a detail of a top portion of the preform of Figure 1C
- Figure 2 shows a detail from a cross section of a neck and cap assembly secured to a bottle neck made from the preform of Figures 1A and 1B;
- Figure 3 shows a detail similar to Figure 2 with the cap removed showing an alternative configuration for the weld position on an inner face of a
- 15 side wall of the bottle neck;
- Figure 4 shows a detail from a cross section of a neck and cap assembly illustrating the use of an oversized foil in a hot filling process using the closure technology of the present invention; and
- Figure 5 shows a section through a spout fitted to a composite container;
- 20 Figure 6 shows a section through an end plate for a can; and
- Figure 7 shows a section through the end plate of Figure 6 after assembly with a spout and can.

Detailed Description of a Preferred Embodiment

The embodiments described with reference to Figures 1-4 are a PET bottle. However,

it will be appreciated that the invention is not limited to bottles of this material but has particular additional advantages when used with PET and PVC bottles where it is difficult to form strong welds. The embodiment in Figure 5 illustrates the use of the closure technology of the invention with an alternative container. The embodiment of
5 Figures 6 and 7 shows the application of the process to a can.

A preform 2 for a PET bottle is injection moulded from PET in a conventional manner. The preform may be made of a modified or blended PET plastics material that provides an improved barrier to gas penetration. For example PET may be blended with PEN. The preform 2 can also be made from PET granules with which a
10 masterbatch has been mixed before melting the granules so that the normal PET is mixed with a barrier masterbatch. The preform 2 could also be coinjected such that it has several layers.

The preform 2 has a body portion 4, which comprises the material which will be stretch blow moulded to form the bottle body, and a neck 6. The neck portion 6 and
15 body portion 4 are separated by a transport ring 8. This ring 8 is created at the junction of two mould parts used to mould the preform. The neck portion 6 has a reduced height relative to a conventional preform with screw threads as the neck portion only needs to be tall enough to support a skirt 20 of a spout 22.

The neck portion 6 is preferably a simple cylindrical side wall 10 devoid of moulded
20 features for maximum economy and minimum weight as shown in Figures 1A and B. However a rib 12 may be formed at or adjacent an open mouth 14 of the neck 6 as shown in Figure 1D to aid in positioning of the spout 22 or to facilitate the removal of the blown PET bottle from the injection stretch blow mould.

The spout 22 is of the same construction as that described in WO 99/61337
25 (Spreckelsen McGeough Ltd) to which reference may be made. In that specification the assembly of spout 22 and cap 24 is referred to as a "neck and cap assembly". The spout 22 has a skirt 20 and a pourer 26 to which a cap 24 is snap fitted. The cap 24 could also be a screw on cap. The skirt 20 merges with the pourer 26 at a horizontal

flange 30. A foil 40 is welded across an opening in the spout and secured to an underside of the flange 30. A ring pull structure 32 is provided inside the pourer 22 to allow the foil 40 to be removed.

In the prior art assembly for use with extrusion blow moulding, the foil 40 is entirely flat but in accordance with a first embodiment of the present invention the foil 40 has a portion 42 that depends downwardly around the inside of the skirt 20 so that it can be welded to an outer surface of the side wall 10. Instead of relying on a weld in a plane of the opening and horizontal flange 30 but rather one between a side wall 10 of the neck portion 6 and the depending portion 42 of the foil 40, a sheer force is applied to the weld when the ring pull structure 32 is used to open the closure or when any attempt is made to lever the assembly from the bottle.

In an alternative embodiment as shown in Figure 3 a flat foil 40 is provided across the whole of the interior of the spout so that when the spout 22 is applied to the bottle body the foil is pushed down adjacent an inner part of the side wall 10. This can be made to happen by the application during an induction heating cycle of downward fitting force over the pourer 26 which is forced into the neck 6 of the bottle as the material of the flange 30 is deformed. An inwardly facing ledge 46 is formed around the interior of the side wall 10 in order to provide a seat for the foil covered flange 30 in its fully inserted position as shown in Figure 3. The lower surface of the foil 40, 44 will also seal to the upper horizontal surface 48 of this ledge 46. In this case an annular portion 44 of the foil 40 which previously lay underneath the outermost part of the flange 30 before the deformation now extends upwards from a central portion of the foil and is welded to the interior of the side wall 10. In its final position therefore the flat foil 40 has adopted a cup shape terminating on or adjacent the horizontal upper surface of the neck portion 6. As in the previously described embodiment the weld against the side wall 10 is also placed in sheer rather than tension when the foil 40 is opened by the ring pull structure 32 or any attempt is made to prise the assembly off by placing a lever under the skirt 20.

Instead of being deformed into the structure shown in Figure 3 a spout may be

moulded in that shape and be designed to be plugged into the neck. In this embodiment the foil portion 44 extends upwardly around the outer side of the spout.

A side wall 10 weld is less sensitive to warping of the neck 6 that may occur during the hot filling process or the application of heat to produce the weld. This may create significant deformations of the top surface of the preform that would make a weld against that surface unachievable while a preform side wall weld is less affected.

Figure 4 illustrates an oversized foil 40 but with the weld to the neck 6 being adjacent the outer face of the side wall 10. This embodiment is specifically adapted for hot filling. Here the foil 40 is puffed up into the interior of the spout during fitting and is allowed to flex inwardly (as shown in the drawing) during cooling after the weld has been formed to partially relieve the vacuum created inside the bottle body. This allows this closure technology to be used with bottle bodies that need less reinforcing pressure panels to withstand the vacuum created after filling.

This type of closure technology will permit hot fill applications in excess of 75°C without the use of preform neck crystallization as some degree of neck deformation can be accommodated by the side wall welding.

In the embodiments described a spout 22 with a snap on cap 24 has been shown. If the bottle is to be used with a carbonated product the pourer 26 would be provided with screw threads to engage with a screw-on over cap for resealing purposes.

Where the bottle body has been coated with an internal or external barrier coating on the inside or outside of the bottle body, the weld with the side wall 10 may be made to the plastics material of the uncoated face or, where the coating is of a weldable material to the coated face. Alternatively the coating may be terminated short of the top of the side wall 10.

In the container shown in Figure 5 equivalent parts are identified by means of the same reference numerals distinguished by a prime symbol. The container shows the use of a spout 22 with a composite container 80 which is a cylinder of laminated

paperboard with a base. In this design the side wall 82 of the container is effectively the side wall of the neck 6 in the terminology used in this specification and claims.

The paperboard laminate (which may include other layers such as aluminium foil or EVOH) has an external and/or internal coating 84 of a plastics coating such as

- 5 polypropylene or polyethylene or PET, which welds to a similar coating on the foil portion 42 against the side wall 6 and also with the horizontal upper surface 86 of the side wall 82.

It will be appreciated that similar designs to that shown in Figure 5 can be used with plastics coated steel cans.

- 10 Both composite and metal containers could also be formed with a plastics or plastics coated top or end plate that defines a separate neck portion to which a spout 22 could be fitted in any of the ways previously described. In this variation the end plate can be assembled together with its spout independently of the filling step and seamed as a complete unit onto the can body.
- 15 Figure 6 illustrates an end plate suitable for this purpose. The plastics coated end plate 90 has an outer edge 92 designed to be sealed or seamed to a can and a central opening 94 that is defined by a side wall 96. The edges 98 of side wall 96 are turned outwardly and downwardly around the opening in order to engage with a skirt 20 of the spout 22. Where only the lower surface of the end plate 90 is plastics coated, this
- 20 configuration exposes the plastics coating 100 to the foil 40. The fitting of the spout to the end plate 90 is then carried out as previously described. Since the seaming of end plates to cans is normally carried out very rapidly it is preferable for the spouts to be pre-assembled to the end plates before the complete assembly is seamed at its edge 92 to a side wall 102 of the can.

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Claims

1. A process for assembling a plastics spout (22) to a neck portion (6) defined by a side wall (10) substantially perpendicular to a plane of aligned openings in the neck portion (6) and spout (22), the side wall (10) being made of or coated with a first plastics material, wherein the spout (22) contains foil (40) that
30 closes the opening in the spout (22), the foil (40) having an exposed face coated with a second plastics material compatible with the first plastics material, the process comprising the steps of placing the spout (22) on the neck portion (6) and characterised by the step of welding a portion of the exposed face of the foil (40) to the first plastics material of a substantially vertical
35 surface of the side wall (10).
2. A process as claimed in claim 1, wherein the portion of the foil is welded to an inner side wall (10) surface of the neck portion (6).
3. A process as claimed in claim 1, wherein the portion of the foil (40) is also welded to an upper surface of an inwardly facing ledge (46) on the inner side
40 wall (10) of the neck portion (6).
4. A process as claimed in claim 1, wherein the portion of the foil (40) is welded to an outer side wall (10) surface of the neck portion (6).
5. A process as claimed in claim 1, wherein the portion of the foil (40) is also welded to a top face of the side wall (10) surrounding the opening.
- 45 6. A process as claimed in any one of the preceding claims, wherein the first plastics material is polypropylene, polyethylene, PET or PVC.
7. A process as claimed in any one of the preceding claims wherein the neck portion (6) is provided on an end plate (90) and the spout (22) is assembled to the end plate (90) and subsequently the end plate (90) is assembly sealed to a
50 filled container.

8. A plastics spout (22) for use in a process as claimed in any one of the preceding claims, comprising a spout (22) defining an opening aligned in a first plane and having a skirt (20) surrounding the opening and extending substantially perpendicular to the first plane; and a foil (40) having a first portion closing the opening and characterised in that a second portion depends around the inside of the skirt (20) so that the second portion can be welded to a side wall (10) of a container at confronting surfaces running axially of the spout (22) in order that such a weld is subjected to a shear force when the foil (40) is torn open.
9. A plastics spout (22) as claimed in claim 8, wherein the first portion of the foil (40) is oversized relative to the size of the opening.
10. A container having a side wall (10) substantially perpendicular to a plane of an opening in the container, the side wall (10) being made of or coated with a first plastics material, and characterised in that a foil (40) is welded to an inner or outer surface of the side wall (10) by means of a coating of plastics material compatible with the first plastics material, the foil (40) extending across the opening defined by the side wall (10) and being sealed to a closure for the container.
11. A container as claimed in claim 10, which is barrier coated.
12. A container as claimed in claim 10, wherein the side wall (10) is smooth above any transport ring (8).
13. A container as claimed in claim 10, wherein the side wall (10) is formed on an end plate (90) which is itself sealed to a container body.