METHOD OF COUPLING A COMPONENT TO A FUEL FILL TUBE

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A component is mated to a parison placed in a blow mold. The parison is configured to define a fuel fill tube.
METHOD OF COUPLING A COMPONENT TO A FUEL FILL TUBE

[0001] This application claims priority under 35 U.S.C. § 119(e) to U.S. Provisional Application Ser. No. 60/653,833, filed Feb. 17, 2005, which is expressly incorporated by reference herein.

BACKGROUND

[0002] The present disclosure relates to blow-molding methods, and particularly to methods of coupling a component to an element formed in a blow mold. More particularly, the present disclosure relates to formation of a fuel tank filler neck using a blow-molding process.

SUMMARY

[0003] In accordance with the present disclosure, a component such as an inlet cup or inlet check valve is mated and bonded to a parison while the parison is located in a closed blow mold. The parison is formed in the blow mold to define a fuel tank filler neck in an illustrative embodiment.

[0004] In accordance with one illustrative method, a vacuum is used to draw a hot parison into a mold cavity and inflation air is blown into a central passageway formed in the hot parison to inflate the parison in the mold cavity. A first filler neck component (e.g., an inlet cup) is mated to a first end of the hot parison in the mold cavity to melt a portion of the first filler neck component and bond the first filler neck component to the first end of the hot parison. A second filler neck component (e.g., an inlet check valve) is mated to a second end of the hot parison in the mold cavity to melt a portion of the second filler neck component and bond the second filler neck component to the second end of the hot parison.

[0005] Features of the present disclosure will become apparent to those skilled in the art upon consideration of the following detailed description of illustrative embodiments exemplifying the best mode of carrying out the disclosure as presently perceived.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The detailed description particularly refers to the accompanying figures in which:

[0007] FIG. 1 is a perspective view of a fuel tank coupled to a tank filler neck including an inlet cup and closure cap at an outer end of the filler neck and an inlet check valve at an inner end of the filler neck;

[0008] FIG. 2 is a sectional view showing a “closed” blow mold in accordance with the present disclosure and showing an extruded uninflated parison located in a mold cavity formed between first and second mold dies and showing an inlet cup arranged to be mated with an upper end of the parison and an inlet check valve arranged to be mated with a lower end of the parison;

[0009] FIG. 3 is a sectional view similar to FIG. 2 after “inflation air” has been blown into the closed blow mold to inflate the parison deployed in the mold cavity and showing the inlet cup after it has been mated with the upper end of the inflated parison and the inlet check valve after it has been mated with the lower end of the inflated parison;

[0010] FIG. 4 is an enlarged sectional view showing a fixture moving toward the closed blow mold and carrying an inlet cup to be mated with an upper end of the inflated parison located in the closed blow mold;

[0011] FIG. 5 is a view similar to FIG. 4 showing the inlet cup mated to the parison before withdrawal of the fixture from the inlet cup and from the closed blow mold; and

[0012] FIG. 6 is a view similar to FIGS. 4 and 5 of another embodiment in accordance with the present disclosure wherein a vacuum is used to draw a parison to mate with an inlet cup positioned as an “insert” in a mold.

DETAILED DESCRIPTION OF THE DRAWINGS

[0013] A vehicle fuel system 10 comprises a fuel tank 12, a filler neck 14 having a lower end 16 coupled to fuel tank 12 and an upper end 18, and a removable closure cap 20 coupled to upper end 18 of filler neck 14 to close an open mouth 22 formed in the upper end of filler neck 14 as shown, for example, in FIG. 1. Vehicle fuel system 10 also comprises an inlet check valve 24 and an inlet cup 26 coupled to filler neck 14 as filler neck 14 is formed in a blow mold 28 using methods disclosed herein as suggested, for example, in FIGS. 2 and 3.

[0014] Inlet check valve 24 is configured to lie in a fuel-conducting passageway 15 formed in filler neck 14 and regulate flow of liquid fuel and fuel vapor therethrough. In the illustrated embodiment, inlet check valve 24 includes a “one-way” valve member 30 that is slidable between a passageway-closing position shown in FIG. 1 and a passageway-opening position (not shown). During refueling, liquid fuel discharged into an “open” filler neck 14 by a fuel-dispensing pump nozzle (not shown) contacts and moves valve member 30 inwardly against a yieldable biasing spring 32 to assume the opened position so that liquid fuel can flow past the one-way valve member 30 and into a fuel reservoir 34 provided in an interior region 36 of fuel tank 12. Reference is made to U.S. Pat. No. 5,568,828 and application Ser. No. 10/810,982, filed Mar. 26, 2004, for disclosures relating to vehicle fuel systems and inlet check valves, which patent and application are hereby incorporated by reference herein.

[0015] Inlet cup 26 includes a mount 38 and a nozzle restrictor 40 coupled to mount 38 and formed to include an aperture 42 as shown, for example, in FIGS. 1 and 4. Mount 38 is coupled to outer end 18 of filler neck 14 by any suitable means and is sized to receive an inner portion of closure cap 20 therein. Aperture 42 is sized to receive a dispensing portion of a pump nozzle (not shown) therein during tank refueling.

[0016] As suggested, for example, in FIG. 2, a hot extruded uninflated parison 44 is drawn using a vacuum 46 through an elongated mold cavity 48 defined by first and second mold dies 51, 52. These mold dies 51, 52 are included in blow mold 28 and are shown in a “closed” position in FIGS. 2-5. It is within the scope of the present disclosure to apply vacuum 46 to elongated mold cavity 48 via either first opening 48' or second opening 48".

[0017] As suggested in FIGS. 2 and 3, inflation air 50 is blown into a central passageway 54 formed in hot extruded parison 44 to inflate parison 44 while parison 44 is deployed in the closed mold cavity 48. As suggested, for example, in
FIG. 3, inflation air 50 expands the thin-walled hot-extruded parison 44 in radially outwardly extending directions to mate with half-round surfaces 151, 152 (or any other suitable surfaces) formed in first and second mold dies 51, 52. While parison 44 is hot, a component such as inlet check valve 24, inlet cup 26, or other suitable element is mated with parison 44 as suggested in FIG. 3 to cause a portion of the component contacting the hot parison 44 to “melt” so that a bond will develop between parison 44 and the mating component as the “hot” materials comprising parison 44 and the mating component solidify as they cool.

[0018] Means is provided for moving a component to mate with a portion of a hot parison 44 to cause a bond to be established between parison 44 and that component. As suggested, for example, in FIGS. 4 and 5, a fixture 60 is provided to carry inlet cup 26 into open mouth 62 of the inflated, hot, extruded parison 44 and hold inlet cup 26 in open mouth 62 until the plastics material comprising mount 38 of inlet cup 26 bonds to parison 44. After cooling has been completed, fixture 60 is withdrawn, leaving inlet cup 26 mated with inflated parison 44 as shown, for example, in FIG. 3.

[0019] In an illustrative embodiment, parison 44 is made of polyarylamide (PAA). Parison 44 could also be made of liquid crystalline polylethylene (LCP). PAA is suitable for blow-molding. LCP is a low-permeation material suitable for blow-molding. Exterior portions of mount 38 can be made of PAA, LCP, or some suitable material that bonds to PAA, LCP, or the material used to make parison 44.

[0020] In other embodiments, mount 38 of inlet cup 26 is made of polyethylene or a combination of polyethylene and acetal. It is within the scope of this disclosure to position inlet cup 26 as an insert in a mold 70 and draw a vacuum 72 using vacuum supply 74 through inlet cup 26 via openings formed in nozzle restrictor 40 to move parison 44 in direction 76 to mate inlet cup 26 to a parison in the mold as suggested diagrammatically in FIG. 6.

[0021] By mating and bonding a component such as inlet cup 26 to parison 44 while parison 44 is located in a closed mold 28, secondary processes are not needed to couple an inlet cup to a filler neck after the filler neck is removed from a mold. Inlet cup 26 is mated and bonded to parison 44 to yield a more robust joint or union between inlet cup 26 and parison 44. An o-ring seal between inlet cup 26 and filler neck 14 may or may not be needed.

[0022] A method of coupling a component to a fuel fill tube in accordance with the present disclosure comprises the steps of providing an elongated mold cavity 48 between a first mold die 51 mated to a second mold die 52, and using a vacuum 46 to draw a hot extruded parison 44 into elongated mold cavity 48 as suggested in FIG. 2. Hot extruded parison 44 is formed to include opposite first and second ends 47, 49 and a central passageway 54 extending therethrough between first and second ends 47, 49.

[0023] The present method further comprises the steps of blowing inflation air 50 through an opening 47 formed in first end 47 into central passageway 54 to inflate hot extruded parison 44 while hot extruded parison 44 is located in elongated mold cavity 48 and mating a first filler neck component 26 to first end 47 of hot extruded parison 44 after inflation of hot extruded parison 44. It is also within the scope of the present disclosure to blow inflation air 50 through an opening 49 formed in second end 49 to enlarge opening 47 in first end 47 to receive first filler neck component 26 therein. The mating step occurs while parison material comprising hot extruded parison 44 that has been heated to a hot temperature above a melting point of component material comprising first filler neck component 26 to (1) transfer heat associated with hot extruded parison 44 to first filler neck component 26 to melt some of the component material included in first filler neck component 26 and (2) cause said some of the component material to mate with parison material in hot extruded parison 44 so that a bond develops between mating portions of hot extruded parison 44 and first filler neck component 26 as hot extruded parison 44 and first filler neck component 26 cool to anchor first filler neck component 26 to the parison 44.

[0024] The mating step further comprises the steps of mounting first filler neck component 26 on a fixture 60 and moving fixture 60 into central passageway 54 formed in hot extruded parison 44 through an opening 47 formed in first end 47 of hot extruded parison 44 to deposit a portion of the first filler neck component 26 in the central passage to facilitate transfer of heat from parison material in hot extruded parison 44 to component material of first filler neck component 26 located in central passageway 54 of hot extruded parison 44 as suggested in FIGS. 4 and 5. The mating step further comprises the steps of separating fixture 60 from first filler neck component 26 after parison 44 and component materials have cooled and bonded to anchor first filler neck component 26 to parison 44.

[0025] The using step further comprises the steps of introducing a hot extruded parison 44 into elongated mold cavity 48 through a first cavity inlet 48 formed in one end of elongated mold cavity 48 while first mold die 51 is mated to second mold die 52 and applying a vacuum 46 to hot extruded parison 44 through a second cavity inlet 48" formed in an opposite end of elongated mold cavity 48 while first mold die 51 is mated to second mold die 52 to move hot extruded parison through elongated mold cavity 48 in a direction 55 toward second cavity inlet 48" as suggested in FIG. 2. The applying step ends before the blowing step begins in an illustrative embodiment. Inflation air 50 is blown through first cavity inlet 48" into central passageway 54 of hot extruded parison 44.

[0026] A second filler neck component 24 is mated to second end 49 of hot extruded parison 44 after inflation of hot extruded parison 44 as suggested in FIGS. 2 and 3. This mating step occurs while parison material comprising the hot extruded parison has been heated to a hot temperature above a melting point of component material comprising second filler neck component 24 to (1) transfer heat associated with hot extruded parison 44 to second filler neck component 24 to melt some of the component material included in second filler neck component 24 and (2) cause said some of the component material to mate with parison material in hot extruded parison 44 so that a bond develops between mating portions of hot extruded parison 44 and second filler neck component 24 as hot extruded parison 44 and second filler neck component 24 cool to anchor second filler neck component 24 to parison 44. It is within the scope of the present disclosure to blow inflation air 50 through
opening 49' formed in second end 49 of parison 44 to enlarge opening 49' to receive second filler neck component 24 therein.

1. A method of coupling a component to a fuel fill tube, the method comprising the steps of

providing an elongated mold cavity between a first mold die mated to a second mold die,

using a vacuum to draw a hot extruded parison into the elongated mold cavity, the hot extruded parison being formed to include opposite first and second ends and a central passageway extending therethrough between the first and second ends,

blowing inflation air into the central passageway to inflate the hot extruded parison while the hot extruded parison is located in the elongated mold cavity, and

mating a first filler neck component to the first end of the hot extruded parison after inflation of the hot extruded parison, while parison material comprising the hot extruded parison that has been heated to a hot temperature above a melting point of component material comprising the first filler neck component, to transfer heat associated with the hot extruded parison to the first filler neck component to melt some of the component material included in the first filler neck component and cause said some of the component material to mate with parison material in the first end of the hot extruded parison so that a bond develops between mating portions of the hot extruded parison and the first filler neck component to anchor the first filler neck component to the first end of the parison.

2. The method of claim 1, further comprising the step of mating a second filler neck component to the second end of the hot extruded parison after inflation of the hot extruded parison, while parison material comprising the hot extruded parison that has been heated to a hot temperature above a melting point of component material comprising the second filler neck component, to transfer heat associated with the hot extruded parison to the second filler neck component to melt some of the component material included in the second filler neck component and cause said some of the component material to mate with parison material in the second end of the hot extruded parison so that a bond develops between mating portions of the hot extruded parison and the second filler neck component to anchor the second filler neck component to the second end of the parison.

3. The method of claim 1, wherein the mating step further comprises the steps of mounting the first filler neck component on a fixture and moving the fixture into the central passageway formed in the hot extruded parison through an opening formed in the first end of the hot extruded parison to deposit a portion of the first filler neck component in the central passage to facilitate transfer of heat from parison material in the hot extruded parison to component material of the first filler neck component located in the central passageway of the hot extruded parison.

4. The method of claim 3, wherein the mating step further comprises the step of separating the fixture from the first filler neck component after the parison and component materials have cooled and bonded to anchor the first filler neck component to the parison.

5. The method of claim 1, wherein the using step further comprises the steps of introducing a hot extruded parison into the elongated mold cavity through a first cavity inlet formed in one end of the elongated mold cavity while the first mold die is mated to the second mold die and applying a vacuum to the hot extruded parison through a second cavity inlet formed in an opposite end of the elongated mold cavity while the first mold die is mated to the second mold die to move the hot extruded parison through the elongated mold cavity in a direction toward the second cavity inlet.

6. The method of claim 5, wherein the applying step ends before the blowing step begins and wherein inflation air is blown through the first cavity inlet into the central passageway of the hot extruded parison.

7. The method of claim 1, wherein each of the first and second mold dies include a half-round surface forming a boundary portion of the elongated mold cavity and wherein the inflation air expands the hot extruded parison in radially outwardly extending directions to mate with the half-round surfaces of the first and second mold dies while the first mold die is mated with the second mold die.

8. The method of claim 7, wherein the mating step further comprises the steps of mounting the first filler neck component on a fixture and moving the fixture into the central passageway formed in the hot extruded parison through an opening formed in the second end of the hot extruded parison to deposit a portion of the first filler neck in the central passage to facilitate transfer of heat from parison material in the hot extruded parison to component material of the first filler neck component located in the central passageway of the hot extruded parison.

9. The method of claim 8, wherein the mating step further comprises the step of separating the fixture from the first filler neck component after the parison and component materials have cooled and bonded to anchor the filler neck component to the parison.

10. A method of coupling a component to an element formed in a blow mold, the method comprising the steps of

bonding the first component to a hot parison while the hot parison is located in a closed blow mold.

11. The method of claim 10, wherein the bonding step comprises the step of providing first and second mold dies lying in mating relation to one another and cooperating to form a portion of the closed blow mold and a mold cavity between the mold dies, the first and second mold dies each including a surface facing toward the hot parison and the other mold die, and the bonding step further comprises the steps of inflating the hot parison in radially outwardly extending directions to mate with the surfaces formed in the first and second mold dies and, while the parison is still hot, mating the first component with the hot parison to cause a portion of the first component contacting the hot parison to melt so that a bond develops between the hot parison and the first component as hot materials comprising the parison and the first component solidify as they cool.

12. The method of claim 1, wherein the bonding step further comprises providing means for moving the first component to mate with the hot parison to cause the bond to be established between the hot parison and the first component, the moving means carrying the first component into an open mouth of the inflated, hot parison and holding the first component in the open mouth until material comprising a
mount of the first component bonds to the hot parison and, after a cooling has been completed, the moving means is withdrawn, leaving the first component mated to and bonded with the inflated parison.

13. The method of claim 12, wherein the first component is an inlet cup including a mount and a nozzle restrictor coupled to the mount and formed to include an aperture and exterior portions of the mount are made of a low-permeation material that bonds to a low-permeation material used to make the hot parison.

14. The method of claim 13, wherein the low-permeation material of the exterior portions of the mount and the low-permeation material used to make the hot parison includes liquid crystalline polyethylene.

15. The method of claim 10, wherein the bonding step comprises the step of providing first and second mold dies lying in mating relation to one another and cooperating to form a portion of the closed blow mold, and the bonding step further comprises the steps of drawing the hot parison using a vacuum through an elongated mold cavity defined by the first and second mold dies, and the bonding step further comprises the step of blowing inflation air into a central passageway formed in the hot parison to inflate the hot parison while the hot parison is deployed in the mold cavity, the inflation air expanding the hot parison in radially outwardly extending directions to mate with half-round surfaces formed in the first and second mold dies, and while the parison is hot, the first component is mated with the hot parison to cause a portion of the first component contacting the hot parison to melt so that a bond will develop between the hot parison and the first component as materials comprising the hot parison and the first component solidify as they cool.

16. The method of claim 15, wherein the materials comprising the hot parison and the first component include low-permeation materials suitable for blow-molding.

17. The method of claim 1, further comprising the step of providing a second component and wherein the bonding step comprises the step of providing first and second mold dies lying in mating relation to one another and cooperating to form a portion of the closed blow mold and a mold cavity therebetween, the first and second mold dies each including a surface facing toward the hot parison and the other mold die, and the bonding step further comprises the steps of inflating the hot parison in radially outwardly extending directions to mate with the surfaces formed in the first and second mold dies and, while the parison is hot, mating the first component with an upper end of the hot parison and mating the second component with a lower end of the hot parison to cause a portion of the first and second components contacting the hot parison to melt so that a bond develops between the hot parison and each of the first and second components as hot materials comprising the parison and the first and second components solidify as they cool.

18. The method of claim 17, wherein the first component is an inlet cup, the second component is an inlet check valve, and the materials comprising the hot parison, the inlet cup, and the inlet check valve include low-permeation materials suitable for blow molding and suitable for bonding the inlet cup and the inlet check valve to the hot parison.

19. The method of claim 18, wherein the inlet cup is made of one or more of polyethylene and acetal, and the hot parison is made of liquid crystalline polyethylene.

20. The method of claim 1, wherein the bonding step comprises the step of providing first and second mold dies lying in mating relation to one another and cooperating to form a portion of the closed blow mold and a mold cavity between the mold dies, the first and second mold dies each including a surface facing toward the other mold die, and the bonding step further comprises the steps of positioning the first component as an insert in the closed blow mold and drawing a vacuum through the first component to mate the first component to the hot parison in the closed blow mold.

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