A plastic aerosol container includes a main body portion and a base portion, both of which are fabricated from a plastic material such as polyethylene terephthalate. The main body portion has a longitudinal axis and a maximum transverse diameter. The base portion is unitary with the main body portion and has a plurality of feet that are adapted to support the container on a horizontal surface. A first rib that is positioned between adjacent feet preferably has a substantially constant radius of curvature that has a ratio with respect to the maximum transverse diameter that is substantially within a range of about 0.20 to about 1.0. The main body portion and the base portion define an interior space that is pressurized with an aerosol mixture at a pressure that is substantially within a range of about 50 psi to about 300 psi.
PLASTIC AEROSOL CONTAINER WITH FOOTED BASE

BACKGROUND OF THE INVENTION

[0001] Field of the Invention

This invention relates broadly to the field of containers that are adapted to hold highly pressurized contents, such as aerosol mixtures, and more particularly to a plastic aerosol container having a footed base portion that is adapted to offer maximum resistance to deformation at high internal pressures.

[0002] Description of the Related Technology

Aerosol containers have conventionally been fabricated from metal, and are conventionally formed as a cylindrical tube having upper and lower end closures. The bottom end closure is typically shaped as a concave dome, and the upper end closure typically includes a manually actutable valve for dispensing the pressurized aerosol contents of the container.

[0003] Metallic containers have certain inherent disadvantages, such as a tendency to rust over time and to scratch surfaces with which they may come into contact.

[0004] Efforts have been made in the past to develop plastic aerosol containers, but have encountered difficulties, mainly relating to controlling the deformation of the plastic material as a result of the high internal pressurization that is necessary in an aerosol container. Aerosol containers commonly require internal pressures of the magnitude of 50-300 psi, which is significantly greater than pressures that are typically encountered in other packaging applications for which plastic material has been used, such as the packaging of carbonated beverages. Accordingly, design considerations for plastic aerosol containers are quite different than they are for lower pressure packaging applications such as plastic beverage containers.

[0005] A plastic aerosol container ideally should be constructed to minimize expansion of the side wall when it is fully pressurized. If the side wall is permitted to expand a significant amount, the container is difficult to convey during the manufacturing process, difficult to package in bulk quantities and is space inefficient in a retail facility. If significant deformation occurs in the base portion of the container, it may be unable to effectively support the container on a horizontal surface, both in the retail facility and in the household.

[0006] A need therefore exists for an improved plastic aerosol container having a base portion that is constructed to offer maximum resistance to deformation at high internal pressures.

SUMMARY OF THE INVENTION

[0007] Accordingly, it is an object of the invention to provide an improved plastic aerosol container that has a base portion that is constructed to offer maximum resistance to deformation at high internal pressures.

[0008] In order to achieve the above and other objects of the invention, a plastic aerosol container according to a first aspect of the invention includes a main body portion that is fabricated from a plastic material, and a base portion that is unitary with the main body portion and fabricated from the plastic material. The base portion has a plurality of feet that are adapted to support the container on a horizontal surface, and at least a first rib that is positioned between adjacent feet. The first rib has a substantially constant radius of curvature.

According to a second aspect of the invention, a plastic aerosol container includes a main body portion that is fabricated from a plastic material. The main body portion has a longitudinal axis and a maximum transverse diameter. The container further includes a base portion that is unitary with the main body portion and fabricated from the plastic material. The base portion has a plurality of feet that are adapted to support the container on a horizontal surface, and at least a first rib that is positioned between adjacent feet. The first rib has a radius of curvature, the radius of curvature having a ratio with respect to the maximum transverse diameter that is substantially within a range of about 0.20 to about 1.0.

A plastic aerosol container according to a third aspect of the invention includes a main body portion that is fabricated from a plastic material, the main body portion having a longitudinal axis and a maximum transverse diameter and a base portion that is unitary with the main body portion and fabricated from the plastic material. The base portion has a plurality of feet that are adapted to support the container on a horizontal surface, and at least a first rib that is positioned between adjacent feet. The first rib has a substantially constant radius of curvature, the substantially constant radius of curvature having a ratio with respect to the maximum transverse diameter that is substantially within a range of about 0.20 to about 1.0. The main body portion and the base portion define an interior space that is pressurized with an aerosol mixture at a pressure that is substantially within a range of about 50 psi to about 300 psi.

These and various other advantages and features of novelty that characterize the invention are pointed out with particularity in the claims annexed hereto and forming a part hereof. However, for a better understanding of the invention, its advantages, and the objects obtained by its use, reference should be made to the drawings which form a further part hereof, and to the accompanying descriptive matter, in which there is illustrated and described a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a side elevational view of a plastic aerosol container that is constructed according to a preferred embodiment of the invention;

[0015] FIG. 2 is a bottom plan view of the plastic aerosol container that is shown in FIG. 1;

[0016] FIG. 3 is a cross-sectional view taken along lines 3-3 in FIG. 2; and

[0017] FIG. 4 is a cross-sectional view taken along lines 4-4 in FIG. 2; and

[0018] FIG. 5 is a fragmentary cross-sectional view of an aerosol valve assembly for the plastic aerosol container that is depicted in FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0019] Referring now to the drawings, wherein like reference numerals designate corresponding structure throughout the views, and referring in particular to FIG. 1, a plastic aerosol container 10 that is constructed according to a preferred embodiment of the invention is preferably fabricated from a plastic material such as polyethylene terephthalate (PET), polyethylene naphthalate (PEN), polyamide (Nylon), or a blend containing some combination of the same from a
plastic preform using a conventional blow molding process, such as the reheat stretch blow molding process.

[0020] As FIG. 1 shows, plastic aerosol container 10 includes a main body portion 12 having a side wall 14 and a finish portion 16 having at least one thread 17 defined thereon. Plastic aerosol container 10 further includes a bottom base portion 18 that is unitary with the main body portion 12, and that together with the main body portion 12 and the finish portion 16 defines an internal space 28. Internal space 28 is preferably filled with a pressurized aerosol mixture 29 that is substantially within a range of about 50 psi to about 300 psi at room temperature, and more preferably within a range of about 100 psi to about 300 psi at room temperature. Room temperature for purposes of this document is defined as a range that is substantially between about 63 degrees F. to about 77 degrees F.

[0021] The container 10 further includes an aerosol valve assembly 40, shown in FIG. 4, which is mounted in a pressure-sealed manner to the finish portion 16.

[0022] The aerosol mixture 29 preferably includes a propellant, which could be a liquefied gas propellant or a compressed or soluble gas propellant. Liquefied gas propellants that could be used include hydrocarbon propellants such as propane, isobutene, normal butane, isopentane, normal pentane and dimethyl ether, and hydrofluorocarbon propellants such as dichloroethane (HFC-152a) and tetrafluoroethane (HFC-134a). Compressed and soluble gas propellants that could be used include carbon dioxide (CO2), nitrous oxide (N20), nitrogen (N2) and compressed air.

[0023] As will be discussed in greater detail below, the plastic aerosol container 10 and its base portion 18 is accordingly constructed and arranged so that it is capable of withstanding an internal pressure of the order of about 50 psi to about 300 psi at room temperature without undergoing significant deformation.

[0024] The plastic aerosol container 10 and the main body portion 12 preferably define a longitudinal axis 30, as is shown in FIG. 1. The main body portion 12 is preferably shaped so that it is substantially symmetrical about the longitudinal axis 30.

[0025] Base portion 18 preferably includes a plurality of support feet 20 that are adapted to support the plastic aerosol container 10 on a horizontal surface. Base portion 18 also preferably includes at least a first rib 22 that is positioned between adjacent feet 20, as is shown in FIGS. 1 and 2.

[0026] In the illustrated preferred embodiment, there are four support feet 20 and accordingly four ribs 22 that are respectively interposed between the support feet 20. Preferably, each of the support feet 20 are substantially the same size and shape, and each of the ribs 22 are also substantially of the same size and shape. Each of the support feet 20 are preferably substantially symmetrical with respect to an opposing support foot 20, and each of the ribs 22 are preferably substantially symmetrical with respect to an opposing rib 22.

[0027] Referring now to FIG. 3, which is a longitudinal cross-section taken along lines 3-3 in FIG. 2, the base portion 18 further preferably includes a central push-up portion 24 that is generally shaped as a concave dome having a radius of curvature R. Each of the ribs 22 are preferably shaped so as to have a substantially constant radius of curvature R, as is shown in FIG. 3. Referring briefly to FIG. 1, it will be seen that the plastic aerosol container 10 has a maximum transverse diameter DMAX. A ratio of the radius of curvature R, with respect to the maximum transverse diameter DMAX is preferably substantially within a range of about 0.20 to about 1.0, more preferably substantially within a range of about 0.40 to about 0.7, and most preferably substantially within a range of about 0.45 to about 0.55.

[0028] The base portion 18 is further constructed to have a reduced surface having a radius of curvature R, between each of the ribs 22 and the central push-up portion 24.

[0029] FIG. 4 is a longitudinal cross-sectional view taken along lines 4-4 in FIG. 2. As FIG. 4 shows, each of the support feet 20 preferably includes a bottom surface 26 that is substantially flat and that is upwardly and inwardly inclined with respect to a horizontal plane at an angle αt, when the plastic aerosol container 10 is in an unpressurized condition. When the plastic aerosol container 10 is in a fully pressurized condition, the bottom surface 26 will deflect downwards to reduce the angle αt and assume a more horizontal orientation. Angle αt is preferably within a range of about 3° to about 15° and more preferably within a range of about 5° to about 10°.

[0030] As FIG. 4 also shows, bottom base portion is constructed so as to have a height H1 measured longitudinally from bottom surface 26 to the top of the central push-up portion 24. The bottom surface 26 of each of the feet 20 is connected to an outer surface of the respective foot by a curved portion having a radius of curvature R1, and to the central push-up portion 24 by another curved portion having a radius of curvature R2.

[0031] Each of the ribs 22 is preferably shaped so that its uppermost portion forms a smooth transition or tangent with respect to the outer surface of the side wall 14 of the main body portion 12.

[0032] In order to give the base portion 18 the requisite strength to resist deformation when the plastic aerosol container 10 is at full pressurization, both the ribs 22 and the support feet 20 are constructed to have a side wall thickness that is substantially greater than the typical side wall thickness that is used, for example, in plastic containers for packaging carbonated beverages. Preferably, the ribs 22 are constructed so as to have an average thickness that is substantially within a range of about 0.025 inch to about 0.120 inch, that more preferably is substantially within a range of about 0.030 inch to about 0.100 inch and that most preferably is substantially within a range of about 0.035 inch to about 0.095 inch.

[0033] The orientation of the plastic material can be measured by the stretch ratio, i.e. the thickness reduction between the plastic preform that is used during the blow molding process and the final product with respect to any one portion of the container 10. The stretch ratio of the ribs 22 is preferably within a range of about 1.0 to about 10.0, more preferably within a range of about 1.2 to about 7.5 and most preferably within a range of about 1.3 to about 6.4. Preferably, the ribs 22 are constructed so that the thickness on a lower portion of the rib 22 is greater than the thickness on an upper portion of the rib 22, and so that the stretch ratio on the upper portion of the rib 22 is greater than it is at the lower portion of the rib 22.

[0034] The average thickness of the support feet 20 is preferably substantially within a range of about 0.150 inch to about 0.050 inch, more preferably substantially within a range of about 0.120 inch to about 0.040 inch, and most preferably substantially within a range of about 0.100 inch to about 0.030 inch. The stretch ratio of each support foot 20 is preferably substantially within a range of about 1.0 to about 10.0, more preferably substantially within a range of about
1.1 to about 9.0, and most preferably substantially within a range of about 1.3 to about 7.6.

[0035] The aerosol valve assembly 40 is mounted to the finish portion 16 in a conventional pressure-sealed manner. Aerosol valve assembly 40 includes a dip tube 42 that is positioned within the internal space 28 of the container 10, and a main body portion 44. A valve stem 46 is biased towards a closed position with respect to the main body portion 44 by means of a spring 48. In the closed position, an orifice 50 is sealed by a gasket 52 so that no product from the internal space 28 is expelled under pressure through the internal passage 56 that is defined within the valve stem 46. An additional conventional dispensing and directing cap may be mounted on the valve stem 46. When the valve stem 46 is depressed, the orifice 50 is opened and product from the internal space 28 is expelled under pressure through the internal passage 56 and through the dispensing and directing cap as an aerosol spray.

[0036] It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A plastic aerosol container, comprising:
a main body portion that is fabricated from a plastic material, and
a base portion that is unitary with said main body portion and fabricated from the plastic material, the base portion having a plurality of feet that are adapted to support the container on a horizontal surface, and at least a first rib that is positioned between adjacent feet, and wherein said first rib has a substantially constant radius of curvature.

2. A plastic aerosol container according to claim 1, wherein said main body portion is substantially symmetrical about a longitudinal axis.

3. A plastic aerosol container according to claim 1, wherein the substantially constant radius of curvature has a ratio with respect to a maximum transverse diameter of the main body portion that is substantially within a range of about 0.20 to about 1.0.

4. A plastic aerosol container according to claim 3, wherein the ratio is substantially within a range of about 0.4 to about 0.7.

5. A plastic aerosol container according to claim 4, wherein the ratio is substantially within a range of about 0.45 to about 0.55.

6. A plastic aerosol container according to claim 1, wherein an interior space that is defined by the main body portion and the base portion is pressurized to a pressure that is substantially within a range of about 50 psi to about 300 psi.

7. A plastic aerosol container according to claim 1, wherein an upper portion of the rib is substantially tangent to an outer surface of a side wall of the main body portion.

8. A plastic aerosol container according to claim 1, wherein said base portion further comprises a second rib that also has a substantially constant radius of curvature, and wherein the second rib is shaped to be symmetrical about a longitudinal axis of the container with respect to the first rib.

9. A plastic aerosol container according to claim 1, wherein the base portion has four feet.

10. A plastic aerosol container according to claim 1, wherein said main body portion and said base portion are fabricated using a blow molding process from a material comprising polyethylene terephthalate.

11. A plastic aerosol container, comprising:
a main body portion that is fabricated from a plastic material, the main body portion having a longitudinal axis and a maximum transverse diameter; and
a base portion that is unitary with said main body portion and fabricated from the plastic material, the base portion having a plurality of feet that are adapted to support the container on a horizontal surface, and at least a first rib that is positioned between adjacent feet, and wherein the first rib has a radius of curvature, the radius of curvature having a ratio with respect to the maximum transverse diameter that is substantially within a range of about 0.20 to about 1.0.

12. A plastic aerosol container according to claim 11, wherein the ratio is substantially within a range of about 0.4 to about 0.7.

13. A plastic aerosol container according to claim 12, wherein the ratio is substantially within a range of about 0.45 to about 0.55.

14. A plastic aerosol container according to claim 11, wherein an interior space that is defined by the main body portion and the base portion is pressurized to a pressure that is substantially within a range of about 50 psi to about 300 psi.

15. A plastic aerosol container according to claim 11, wherein an upper portion of the first rib is substantially tangent to an outer surface of a side wall of the main body portion.

16. A plastic aerosol container according to claim 11, wherein said base portion further comprises a second rib that also has a substantially constant radius of curvature, and wherein the second rib is shaped to be symmetrical about a longitudinal axis of the container with respect to the first rib.

17. A plastic aerosol container according to claim 11, wherein the base portion has four feet.

18. A plastic aerosol container according to claim 11, wherein said main body portion and said base portion are fabricated using a blow molding process from a material comprising polyethylene terephthalate.

19. A plastic aerosol container, comprising:
a main body portion that is fabricated from a plastic material, the main body portion having a longitudinal axis and a maximum transverse diameter;
a base portion that is unitary with the main body portion and fabricated from the plastic material, the base portion having a plurality of feet that are adapted to support the container on a horizontal surface, and at least a first rib that is positioned between adjacent feet, and wherein the first rib has a substantially constant radius of curvature, the substantially constant radius of curvature having a ratio with respect to the maximum transverse diameter that is substantially within a range of about 0.20 to about 1.0; and wherein
the main body portion and the base portion define an interior space that is pressurized with an aerosol mixture at
a pressure that is substantially within a range of about 50 psi to about 300 psi.

20. A plastic aerosol container according to claim 19, wherein the main body portion and the base portion are fabricated using a blow molding process from a material comprising polyethylene terephthalate.