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Lightweight metal container

The present invention relates to a lightweight aluminum-base alloy container capable of withstanding a substantial internal pressure without eversion comprising a unitary structure having a seamless cylindrical side wall and a bottom wall integrally formed with the side wall at the lower extremity thereof. The bottom of the inventive container has an improved configuration to provide for adequate column strength along the vertical axis of the container as well as stability against internal pressure generated by the contents of the container after it has been closed and sealed.

There have been numerous container configurations produced by manufacturers and this has been especially true for the two-piece container manufacturer, that is, a container having a body that has an integral bottom wall at an end and the opposite end is configured to have a closure secured thereto. Container manufacturers package beverages of various types in these containers formed of either steel or aluminum alloys. The most ideal type of container bottom wall would be a flat wall which would allow for maximum capacity for a given container with a minimum height. However, such a container is not economically feasible because in order to prevent deformation the thickness of the bottom wall would have to be of such magnitude that the cost of the container would be prohibitive. In order to negate these costs drawing and ironing processes have been installed and extensively used in recent years, especially for the aluminum container industry. In the production of these containers that utilize drawing and ironing it is important that the body wall and bottom wall of the container be as thin as possible so that the container can be sold at a competitive price. Much work has been done on thinning the body wall.

Aside from seeking thin body wall structures various bottom wall configurations have been investigated. In this regard strength of the container was a paramount factor in these investigations. An early attempt in seeking sufficient rigidity of the bottom wall is to form the same into a spherical, dome configuration. The bottom wall is thereby provided with an outwardly concave dome or depression which extends substantially throughout the bottom wall of the container. In effect, this domed configuration provides increased strength and resists deformation of the bottom wall under increased internal pressure of the container with little change in the overall geometry of the bottom wall throughout the pressure range for which the container is designed.

Various modifications of the dome configuration have been manufactured. In this regard, the dome structure itself was integrally formed with other curvilineal or walled members, usually at different inclinations to that of the longitudinal axis of the container in order to further strengthen the container structure. Although such modifications rendered improved rigidity and stability it has been found that such characteristics can still be achieved and in some aspects even improved upon with a minimum of metal being required. Although this domed configuration allows container manufacturers to somewhat reduce the metal thickness, these manufacturers are continuously working on techniques that will allow for further reduction in metal thickness without sacrificing container rigidity. An optimized configuration has not been an easy task.

A number of containers are known and described in the patent literature having a circular side wall and an integral bottom wall comprising an inwardly domed panel having a nose or connecting portion around the periphery thereof that merges with the side wall. The connecting portion itself generally comprises an annular supporting member or bead having connected thereto an arcuate section or sections. Containers provided with this general type of bottom structure are illustrated in a number of prior art examples. For example, one example discloses a container having an integral bottom with a domed center panel recessed inwardly, and another example shows a can structure having an integral bottom portion provided with a bead member with inclined surfaces and recessed domed panel. A further prior art example shows a can bottom defined by inclined surfaces extending from the side wall and a recessed domed center panel. A still further prior art example is a container having outer and inner inclined surfaces with a recessed domed center panel. Also, the prior art discloses a container having a bottom wall including an ellipsoidal dome surrounded by a substantial vertical wall portion which merges with the side wall of the container along an outwardly directed bead. Finally, the prior art discloses a container having a domed center portion that is recessed inwardly.

As is known, a large quantity of containers are manufactured annually and the producers thereof are always seeking to reduce the amount of metal utilized in making containers while still maintaining the same operating characteristics. Simply, a change in equipment could be very costly. Because of the large quantities of containers manufactured a small reduction in metal thickness, even on the order of one thousandths of an inch, would definitely reduce manufacturing costs substantially. Of course, reduction in metal thickness cannot be exercised indiscriminately since failure of packaged materials would often result and especially with the packaging of pressurized materials such as beer, ale or other carbonated beverages which exert a high pressure in the container.

The prior art situation is described in such patents as U.S. patents Nos. 3,693,828, 4,048,934, 3,730,383, 3,979,009, 3,998,174 and 3,942,673, French Patent No. 425,592 and Swiss Patent No. 321,509.

The object of the invention is to provide an improved bottom structure that can be manufactured with less metal and yet be consistent with strength and volume requirements for containers of almost the same general appearance.

According to the present invention, this object is achieved by a lightweight aluminum-base alloy container capable of withstanding a substantial internal pressure without eversion comprising a unitary structure having a seamless cylindrical side wall and a bottom wall integrally formed with the side wall at the lower extremity thereof, wherein the ratio of the thickness of said bottom wall to the thickness of said side wall being no greater than 3.0. said bottom wall comprising tapering surfaces extending downwardly from the side wall, said tapering surfaces forming a taper angle of between 1.3° and about 2.2° and a wall tapering in thickness in the range of 0.01524 cm (0.006 inch) to about 0.0254 cm (0.010 inch) in excess of the side wall, an outer frustoconical surface extending downwardly and inwardly from said side wall toward the axis of said container, said outer frustoconical surface forming a bottom angle of between 35° and about 45° with respect to the axis of the container, a bottom radius integrally connected with said outer frustoconical surface providing an annular supporting surface of the container, said annular supporting surface having a diameter in the range of 5.207 cm (2.05 inch) to about 5.588 cm (2.2 inch), an inner frustoconical surface integrally connected with said bottom radius and extending upwardly and inwardly from said annular supporting surface toward the axis of the container, said inner frustoconical surface forming an angle in the range of $12° \pm 4°$ with respect to the axis of the container, the height of said inner frustoconical surface being less than half the height of said outer frustoconical surface, and a downwardly concaved center panel integrally connected with said inner frustoconical surface and extending upwardly and inwardly from said inner frustoconical surface to the axis of said container, the radius of curvature of said downwardly concaved center panel being between about 5.715 cm (2.250 inch) and about 7.62 cm (3.000 inch), said center panel extending at its uppermost portion slightly above said height of said outer frustoconical surface.

The instant invention is directly concerned with providing an aluminum-base alloy container configuration made with slightly less metal than containers of almost similar structural appearance. Although the amount of aluminum saved per container is small, it certainly is significant since many thousands of containers are produced and therefore any savings would be substantial.

The particular aluminum container of the subject invention is profiled in such a way that column strength, pressure stability and other characteristics are not jeopardized yet the amount of metal utilized in producing the container structure is slightly yet significantly reduced. In particular, the container is specifically configured to be capable of withstanding substantial internal pressure without deforming in the order of 6.55 bar (95 psi) and loads of the order of 158.9 kg (350 pounds) and still retaining its serviceability. Moreover, the instant invention is concerned with providing a seamless metal can structure that is particularly advantageous as regards minimal metal thickness for a domed configured can bottom consistent with other strength and stability requirements. The improved configuration of the container bottom of the instant invention is such that where the container is a drawn and ironed container it can be readily formed in the tool pack of a conventional or standard draw and iron can bodymaker and at the end of the ironing operation so that no separate and costly operation need be used.

It is known that a beverage carrying a charge of carbon dioxide when packaged in a relatively thin drawn and ironed metal container has a tendency to evert or buckle outwardly when exposed to the forces that develop within such a container under certain conditions, and especially during pasteurization or storage at warm temperatures. As noticed by the aforementioned collection of prior art patents, container manufacturers have been striving endlessly to produce a competitively priced container that has sufficient resistance to eversion or buckling when exposed to high pressures that often develop within the container. Although the varied configurations of the prior art have admittedly answered well, they have fallen short of the optimum. The subject invention provides a savings in metal over related structures because of the thinner gauges employed and a balance of structural components comprising the metal container of the profiles herein described and defined.

The objects and advantages of this invention will be apparent to those skilled in the art from the following description of the accompanying drawings, in which:

Figure 1 is an elevated view in partial section showing a container body with an end profile in accordance with the subject invention;

Figure 2 is a fragmentary cross-sectional illustration of the bottom portion of a container of the subject invention; and

Figure 3 is a greatly enlarged fragmentary illustration of bottom body area of a container showing the novel tapered configuration of the subject invention.

In accordance with several important aspects of this invention, the bottom portion of the metal container is provided with a specially configured feature to be described in more detail herein.

With reference to the drawings, Figure 1 depicts a seamless metal container 17 provided with a side wall 10 and an outer substantially frustoconical surface 11 extending downwardly and inwardly from the side wall 10 to the axis of said container, an annular bead 15 extending from the first frustoconical surface providing an annular supporting surface for the container, an inner substantially frustoconical surface 13 extending upwardly and inwardly from the annular head 15 toward the axis of the container, and a recessed domed center panel 12 extending upwardly and inwardly from the inner frustoconical surface to the axis of the container. It should be stated that container body 17 may be readily produced in a draw and iron press, the container bottom 18 being integrally connected to the side wall 10 and can be easily shaped on a standard and appropriate bottom doming device.

Referring now to Figure 3 there is shown a greatly enlarged view of a tapered configuration of the subject invention where the side wall 10 and outer frustoconical surface 11 unite. In particular, this configuration is integrally connected with the side wall and comprises a taper angle G formed from a point O one side of which is parallel to the inner side wall and the other being tangent to an inner sloping side 19. It has been found that the taper angle G should be between about 1.3° and about 2.2°. The taper thickness and taper angle affects such container qualities as denting as well as column strength and the subject invention has substantially optimized these characteristics for the containers herein described.

As shown in further detail in Figure 2, the container bottom 18 is provided with a recessed domed center panel 12 that is so configured that it approximates the segment of a sphere having a radius of curvature J and recessed to a particular height K. It is preferred that the height of the inner frustoconical surface P be substantially less than the height of outer frustoconical surface. In accordance with this invention it is preferred that the height of the inner frustoconical surface P be less than half the height of the outer frustoconical surface. The inner frustoconical surface 13 and the axis of the container form an angle E which has been found to lie in the range of about 8° to about 20°. In particular, the preferred range for aluminum containers is about 12°±4.

The outer frustoconical surface 11 and the axis of the container form a further angle F. It has been found that the angle F be limited to a range of about 35° to about 45° with 40° being preferred. It will be appreciated that as the angle F increases the concavity of the bottom radius 15 decreases and would result in a smaller diameter of support H. Of course, too small a radius of support H for a given container would render it less stable and more likely to tip over.

An important aspect of the instant invention is the wall tapering in thickness. This is depicted in Figure 3 as C therein and is the added thickness in excess of the wall thickness D. In general, the side wall thickness for a 12 ounce aluminum container is about 0.012446 cm (0.0049 inch)±0.001016 cm (0.0004 inch).

Thus, the tapering of wall 19 adds a slight but additional thickness, referred to as wall tapering in thickness and has been found to most advantageous when about 0.02285 cm (0.009 inch)±0.00254 cm (0.001 inch) for aluminum containers.

The aforementioned wall tapering in thickness in conjunction with the wall taper angle when in ranges herein disclosed provide a very economical metal container having suitable column strength and internal pressure rigidity.

Of course, the wall tapering in thickness and side wall thickness are integral and are not separate one from the other. When total maximum thickness is reached, namely about 0.03429 cm (0.0135 inch) for aluminum containers, the outer frustoconical surface is reached, this surface having a thickness of about the starting container stock thickness.

Illustrative dimensions for aluminum containers of Figures 1 and 2 are as follows where the thickness of the center panel is 0.03429 cm (0.0135 inch) for aluminum.

	For cans having a body diameter L of about 6.6 cm (2.6 inch)	
	Aluminum	
Metal Thickness, M	0.03429 cm	(0.0135 inch)
Wall Thickness, D	0.012446 cm	(0.0049 inch)
Diameter of the Annular Supporting Surface, H	5.461 cm	(2.150 inch)
Dome Depth, K	0.9271 cm	(0.3650 inch)
Height of Outer Surface, N	0.69596 cm	(0.274 inch)
Height of Inner Surface, P	0.26162 cm	(0.103 inch)
Center Panel Radius, J	5.969 cm	(2.3500 inch)
Bottom Angle, F	40°	
Dome Wall Angle, E	12°	
Wall Taper Angle, G	2°	
Wall Taper Thickness, C	0.02286 cm	(0.0090 inch)
Can Weight, kg · 1000	13.166	(29.0 Lbs)
Stability Angle, Filled	24°	
Column strength, kg	204.3	(450 Lbs)
Eversion Resistance, barg	6.897	(100 psig)
Ratio of Radius of Curvature (J) to Diameter of the Annular Supporting Surface (H): 2J/H	2.186	
Ratio of Metal Thickness to Wall Thickness: M/D	3.0	

	For cans having a body diameter L of about 6.3 cm (2.47 inch)	
	Aluminum	
Metal Thickness, M	0.03429 cm	(0.0135 inch)
Wall Thickness, D	0.012446 cm	(0.0049 inch)
Diameter of the Annular Supporting Surface, H	5.334 cm	(2.100 inch)
Dome Depth, K	0.889 cm	(0.3500 inch)
Height of Outer Surface, N	0.57912 cm	(0.228 inch)
Height of Inner Surface, P	0.25908 cm	(0.102 inch)
Center Panel Radius J	5.969 cm	(2.3500 inch)
Bottom Angle, F	40°	
Dome Wall Angle, E	12°	
Wall Taper Angle, G	2°	
Wall Taper Thickness, C	0.02286 cm	(0.0090 inch)
Can Weight, kg · 1000	13.075	(28.8 Lbs)
Stability Angle, Filled	22°	
Column Strength, kg	217.9	(480 Lbs)
Eversion Resistance, barg	7.242	(105 psig)
Ratio of Radius of Curvature (J) to Diameter of the Annular Supporting Surface (H): 2J/H	2.38	
Ratio of Metal Thickness to Wall Thickness: M/D	3.0	

Stability of a metal container is an important factor to the maker and to the consumer. Unstable cans interfere with the operation of the filling and packing machinery. Such machinery operates at high speed and cans which rock or wobble excessively cannot be handled by the machinery. From the viewpoint of the consumer, a can which tips or wobbles is not satisfactory. Stability of a can body was measured by placing a can on a flat and level surface and gradually tipping from vertical until an angle is reached at which the can becomes unstable and tips over and at about this instant the angle from the can center line to vertical is recorded and is called the stability angle.

As for the column strength determination, measurements were made by placing the can body vertically and pressing it downward on a base plate of standard testing machine and a force is applied at a constant rate to the upper end of the can body, evenly distributed around the upper edge, and at the instance the can body fails the force is observed and recorded.

As is known, cans employed for the packaging of pressurized products such as beer or carbonated beverages must be able to withstand internal pressures of about 6.55 bar (95 psi). Beer is usually pasteurized in the filled and sealed can at a temperature and for a time which results in an internal pressure of 5.86 bar (85 psi). Generally to allow for error of temperature or time, the minimum acceptable pressure capacity of 6.21 bar (90 psi). On the other hand, carbonated beverages vary according to the degree of carbonation. The highest degree of carbonation is encountered with club soda water which may produce an internal pressure at 37.8°C (100°F) of about 6.55 bar (95 psi). Since the same can body should be useful for all pressurized beverages 6.55 bar (95 psi) is taken as the minimum pressure capability. In order to determine eversion resistant the amount of pressure that a can body can withstand is measured. The can bottom is clamped by a side wall so that the side wall is sealed and the can bottom is unsupported and free. Hydraulic fluid is introduced into the can and the pressure indicated by a guage. At the instant the can bottom reverses from concave outward to convex outward the pressure is observed and recorded.

It has been found that the instant invention provided a significant increase in resistance to eversion so that more rigid and stiffer containers can be produced by having the dimensions described herein.

It will be readily appreciated that when the radius of curvature J of the center panel 12 is made smaller there is more resistance to eversion of the center panel than a container having a larger radius of curvature. It has been determined, however, that it was advantageous not to make a metal container with too small a radius of curvature. At first it was thought that by going to a larger radius of curvature the center panel would thereby be made structurally weaker and unserviceable due to the likelihood of eversion. On the contrary, it was surprising to find that the container itself having the configuration herein described was made stronger. Not only was the average or mean eversion resistance increased thereby, but also the range of pressure at which failure occurred was markedly reduced around that mean. It was further observed that in those few cases where failure did occur it was not catastrophic because the failure did not affect the bottom annular surface which supports the containers and therefore the container would still remain in its upright position.

From the above it is clear that an essential feature of the instant invention is the degree of curvature of the domed panel itself. As already stated, the greater the concavity of such a panel the greater its strength. In this regard, however, it was discovered that the concavity must not be too great and that the radius of curvature for the dome panel must be greater than the diameter of the annular supporting surface, i.e., J>H. This relationship is important in that by having a predetermined range for the radius of curvature the forces that come to bear upon the dome surface to cause eversion are in balance or substantially equal to that acting upon the inner frustoconical surface to cause its eversion. The analogy of a chain being no stronger than its weakest link would be appropriate here. In the subject invention the forces required to cause eversion or buckling of the dome would be equal or substantially equal to those required to cause eversion of buckling of the inner frustoconical wall. In effect, there is an equalized strengthening of the load-bearing properties for the respective structural elements or surfaces of the subject invention. Simply, the two inner contiguous surfaces of the container bottom, vis., the dome and its connecting inner frustoconical surface, have in accordance with this invention been equalized or substantially equalized in their load bearing capacity. In addition to this strengthening feature of the container bottom, the relatively larger radius of curvature allows a somewhat flatter dome so that a container manufacturer is able to produce a slightly smaller body diameter or container height and still contain a volume equal to that of the prior art container (i.e., conventional 355 ml (12 ounce) can) which has a slightly higher dome by virtue of a smaller radius of curvature.

It has been found, moreover, that the fluid volume to metal weight ratio for the container made in accordance with this invention is greater than similar prior art containers. Thus, the subject invention may use relatively thin metal stocks, i.e., thickness in the range of about 0.03429 cm (0.0135 inch) or less for aluminum stock. In general, it has been determined that the ratio of panel wall thickness to side wall thickness for aluminum containers should be 3.00 or less.

When such thick stock materials are employed and are made to conform to the other structural features herein defined and claimed there is found a substantial savings in metal as compared to cans of similar configuration but not possessing these optimum characteristics.

Furthermore, as already alluded to, the stability of the container after eversion is enhanced by the subject invention in that the container disclosed herein remains stable. It will be appreciated that a container having a smaller radius of curvature or greater concavity for the dome would more than likely upon eversion result in an unstable container due to the outwardly everted portion of the bottom structure that would extend beyond the supporting member.

From the above it can be said that when the radius of curvature of the dome is larger than the diameter of the annular supporting surface there are advantages of this relationship in that (1) there is substantial equalization of load bearing characteristics of the dome and the inner surface so that the forces or pressures that would tend to evert either the dome or the inner surface are about equal, (2) a slightly smaller body diameter or container height may be manufactured since a given container would have a slightly flatter dome and as a result the fluid volume to weight ratio for the container would be greater than that of the prior art, and lastly (3) there would be a tendency to a better stability of the container even after eversion. It will be appreciated upon further consideration of these advantages that the first two would lessen the amount of metal required to construct a container.

A wide range of aluminum-base alloys may be used for container stock to produce the containers in accordance with the subject invention. Although a wide range of aluminum-base alloys may be employed for the container stock of the subject invention, a preferred aluminum-base alloy is 3004 H-19 aluminum-base stock of good drawing and ironing quality.

It will be appreciated that a container constructed in accordance with the teachings of the present invention will allow the manufacturer to reduce the metal utilized without sacrificing rigidity or substantially decreasing the resistance to eversion usually achieved by using a material having a thickness corresponding to what is presently used for these types of containers.

Claims

1. A lightweight aluminum-base alloy container (17) capable of withstanding a substantial internal pressure without eversion comprising a unitary structure having a seamless cylindrical side wall (10) and a bottom wall (18) integrally formed with the side wall (10) at the lower extremity thereof, wherein the ratio of the thickness of said bottom wall (18) to the thickness of said side wall (10) being no greater than 3.0, said bottom wall (18) comprising tapering surfaces extending downwardly from the side wall (10), said tapering surfaces forming a taper angle of between 1.3° and about 2.2° and a wall tapering in thickness in the range of 0.01524 cm (0.006 inch) to about 0.0254 cm (0.010 inch) in excess of the side wall (10), an outer frustoconical surface (11) extending downwardly and inwardly from said side wall (10) toward the axis of said container, said outer frustoconical surface forming a bottom angle of between 35° and about 45° with respect to the axis of the container (17), a bottom radius integrally connected with said outer frustoconical surface (11) providing an annular supporting surface (15) of the container, said annular supporting surface (15) having a diameter in the range of 5.207 cm (2.05 inch) to about 5.588 cm (2.2 inch), an inner frustoconical surface (13) integrally connected with said bottom radius and extending upwardly and inwardly from said annular supporting surface (15) toward the axis of the container, said inner frustoconical surface (13) forming an angle in the range of 12°±4° with respect to the axis of the container, the height of said inner frustoconical surface (13) being less than half the height of said outer frustoconical surface (11), and a downwardly concaved center panel (12) integrally connected with said inner frustoconical surface (13) and extending upwardly and inwardly from said inner frustoconical surface (13) to the axis bf said container (17), the radius of curvature of said downwardly concaved center panel (12) being between about 5.715 cm (2.250 inch) and about 7.62 cm (3.000 inch), said center panel (12) extending at its uppermost portion slightly above said height of said outer frustoconical surface (11).

2. The container as recited in claim 1, wherein the cylindrical side wall (10) is in the range of 0.008636 cm (0.0034 inch) to about 0.01397 cm (0.0055 inch) in thickness.

3. A lightweight aluminum-base alloy container (17) capable of withstanding a substantial internal pressure without eversion comprising a unitary structure having a seamless cylindrical side wall (10) and a bottom wall (18) integrally formed with the side wall (10) at the lower extremity thereof, wherein the ratio of the thickness of said bottom wall (18) to the thickness of said side wall (10) being 3.0, said bottom wall (18) comprising tapering surfaces extending downwardly from the side wall (10), said surfaces forming a taper angle of 2° and a wall tapering in thickness from 0.02286 cm (0.009 inch) in excess of said side wall (10), an outer frustoconical surface (11) extending downwardly and inwardly from said side wall (10) toward the axis of said container (17), said outer frustoconical surface (11) forming a bottom angle of 40° with respect to the axis of the container (17), a bottom radius integrally connected with said outer frustoconical surface (11) providing an annular supporting surface (15) for the container, an inner frustoconical surface (13) integrally connected with said bottom radius and extending upwardly and inwardly from said annular supporting surface (15) toward the axis of the container, said inner frustoconical surface (13) forming an angle of 12° with respect to the axis of the container, the height of said inner frustoconical surface (13) being less than half the height of said outer frustoconical surface (11), and a downwardly concaved center panel (12) integrally connected with said inner frustoconical surface (13) and extending upwardly and inwardly from said inner frustoconical surface (13) to the axis of said container, the radius of curvature of said downwardly concaved center panel (12) being greater than the diameter of the annular supporting surface (15), the ratio of the radius

of curvature to half the diameter of the annular supporting surface (15) being about 2.2, said center panel (12) extending at its uppermost portion slightly above said height of said frustoconical surface (15).

4. The container as recited in claims 1, 2 or 3, wherein the thickness of said side wall (10) of said container is about 0.012446 cm (0.0049 inch)±0.001016 cm (0.0004 inch) and the center panel (12) thickness is about 0.03429 cm (0.0135 inch).

5. The container as recited in any one of the preceding claims, wherein the diameter of the annular supporting surface (15) of the container is about 5.461 cm (2.150 inch).

6. The container as recited in any one of the preceding claims 1, 2, 3 or 4, wherein the diameter of the annular supporting surface (15) of the container is about 5.334 cm (2.100 inch).

7. The container as recited in any one of the preceding claims, including a body diameter of about 6.604 cm (2.600 inch).

8. The container as recited in any one of the preceding claims, wherein the radius of curvature of the downwardly concaved center panel (12) is about 5.969 cm (2.350 inch).

9. The container as recited in any one of the preceding claims, wherein the aluminum-base alloy is 3004 H-19.

Patentansprüche

1. Leichtgewichtiger Aluminiumbasislegierungsbehälter (17), der einem wesentlichen Innendruck ohne Ausstülpung widerstehen kann, umfassend einen einheitlichen Aufbau, der eine nahtlose zylindrische Seitenwand (10) hat, sowie eine Bodenwand (18), die integral mit der Seitenwand (10) am unteren äußersten Ende derselben ausgebildet ist, dadurch gekennzeichnet, daß das Verhältnis der Dicke der Bodenwand (18) zur Dicke der Seitenwand (10) nicht größer als 3,0 ist; daß die Bodenwand (18) abgeschrägte Oberflächen aufweist, die sich von der Seitenwand (10) nach abwärts erstrecken; daß die abgeschrägten Oberflächen einen Abschrägungswinkel zwischen 1,3° und etwa 2,2° und eine Wandkonizität in der Dicke im Bereich von 0,01524 cm (0,006 Zoll) bis etwa 0,0254 cm (0,010 Zoll) im Überschuß der Seitenwand (10) bilden; daß eine äußere kegelstumpfförmige Oberfläche (10) vorgesehen ist, die sich nach abwärts und einwärts von der Seitenwand (10) nach der Achse des Behälters zu erstreckt; daß die äußere kegelstumpfförmige Oberfläche einen Bodenwinkel zwischen 35° und etwa 45° bezüglich der Achse des Behälters (17) bildet; daß ein Bodenradius vorgesehen ist, der integral mit der äußeren kegelstumpfförmigen Oberfläche (11) verbunden ist und eine ringförmige Abstützungsoberfläche (15) des Behälters bildet; daß die ringförmige Abstützungsoberfläche (15) einen Durchmesser im Bereich von 5,207 cm (2,05 Zoll) bis etwa 5,588 cm (2,2 Zoll) hat; daß eine innere kegelstumpfförmige Oberfläche (13) vorgesehen ist, die integral mit dem Bodenradius verbunden ist und sich von der ringförmigen Abstützungsoberfläche (15) nach aufwärts und einwärts nach der Achse des Behälters zu erstreckt; daß die innere kegelstumpfförmige Oberfläche (13) einen Winkel im Bereich von 12°±4° bezüglich der Achse des Behälters bildet; daß die Höhe der inneren kegelstumpfförmigen Oberfläche (13) geringer als die Hälfte der Höhe der äußeren kegelstumpfförmigen Oberfläche (11) ist; und daß eine nach abwärts konkave Mittelplatte (12) vorgesehen ist, die integral mit der inneren kegelstumpfförmigen Oberfläche (13) verbunden ist und sich von der inneren kegelstumpfförmigen Oberfläche (13) nach aufwärts der und einwärts zu der Achse des Behälters erstreckt; daß der Krümmungsradius der nach abwärts konkaven Mittelplatte (12) zwischen etwa 5,715 cm (2,250 Zoll) und etwa 7,62 cm (3,000 Zoll) beträgt; und daß sich die Mittelplatte (12) in ihrem obersten Teil ein wenig über der Höhe der äußeren kegelstumpfförmigen Oberfläche (11) erstreckt.

2. Behälter nach Anspruch 1, dadurch gekennzeichnet, daß die Dicke der zylindrischen Seitenwand (10) im Bereich von 0,008636 cm (0,0034 Zoll) bis etwa 0,01397 cm (0,0055 Zoll) beträgt.

3. Leichtgewichtiger Aluminiumbasislegierungsbehälter (17), der einen wesentlichen Innendruck ohne Ausstülpung widerstehen kann, umfassend einen einheitlichen Aufbau, der eine nahtlose zylindrische Seitenwand (10) hat, sowie eine Bodenwand (18), die integral mit der Seitenwand (10) am unteren äußersten Ende derselben ausgebildet ist, dadurch gekennzeichnet, daß das Verhältnis der Dicke der Bodenwand (18) zur Dicke der Seitenwand (10) den Betrag 3,0 hat; daß die Bodenwand (18) abgeschrägte Oberflächen aufweist, die sich von der Seitenwand (10) nach abwärts erstrecken; daß diese Oberflächen einen Abschrägungswinkel von 2° und eine Wandkonizität in der Dicke von 0,02286 cm (0,009 Zoll) im Überschuß der Seitenwand (10) bilden; daß eine äußere kegelstumpfförmige Oberfläche (11) vorgesehen ist, die sich nach abwärts und einwärts von der Seitenwand (10) nach der Achse des Behälters (17) zu erstreckt; daß die äußere kegelstumpfförmige Oberfläche (11) einen Bodenwinkel von 40° bezüglich der Achse des Behälters (17) bildet; daß ein Bodenradius vorgesehen ist, der integral mit der äußeren kegelstumpfförmigen Oberfläche (11) verbunden ist und eine ringförmige Abstützungsoberfläche (15) für den Behälter bildet; daß eine innere kegelstumpfförmige Oberfläche (13) vorgesehen ist, die integral mit dem Bodenradius verbunden ist und sich von der ringförmigen Abstützungsoberfläche (15) nach der Achse des Behälters zu erstreckt; daß die innere kegelstumpfförmige Oberfläche (13) einen Winkel von 12° bezüglich der Achse des

Behälters bildet; daß die Höhe der inneren kegelstumpfförmigen Oberfläche (13) geringer als die Hälfte der Höhe der äußeren kegelstumpfförmigen Oberfläche (11) ist; und daß eine nach abwärts konkave Mittelplatte (12) vorgesehen ist, die integral mit der inneren kegelstumpfförmigen Oberfläche (13) verbunden ist und sich von der inneren kegelstumpfförmigen Oberfläche (13) nach aufwärts und einwärts zu der Achse des Behälters erstreckt; daß der Krümmungsradius der nach abwärts konkaven Mittelplatte (12) größer als der Durchmesser der ringförmigen Abstützungsoberfläche (15) ist; daß das Verhältnis des Krümmungsradius zur Hälfte des Durchmessers der ringförmigen Abstützungsoberfläche (15) etwa 2,2 beträgt; und daß sich die Mittelplatte (12) in ihrem obersten Teil ein wenig über der Höhe der kegelstumpfförmigen Oberfläche (14) erstreckt.

4. Behälter nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß die Dicke der Seitenwand (10) des Behälters etwa 0,012446 cm (0,0049 Zoll)±0,001016 cm (0,0004 Zoll) ist, und daß die Dicke der Mittelplatte (12) etwa 0,03429 cm (0,0135 Zoll) ist.

5. Behälter nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß der Durchmesser der ringförmigen Abstützungsoberfläche (15) des Behälters etwa 5,461 cm (2,150 Zoll) ist.

6. Behälter nach einem der vorhergehenden Ansprüche 1, 2, 3 oder 4, dadurch gekennzeichnet, daß der Durchmesser der ringförmigen Abstützungsoberfläche (15) des Behälters etwa 5,334 cm (2,100 Zoll) ist.

7. Behälter nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß der einen Körperdurchmesser von etwa 6,604 cm (2,600 Zoll) aufweist.

8. Behälter nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß der Krümmungsradius der nach abwärts konkaven Mittelplatte (12) etwa 5,969 cm (2,350 Zoll) ist.

9. Behälter nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Aluminiumbasislegierung 3004 H-19 ist.

Revendications

1. Récipient (17) en alliage léger à base d'aluminium capable de résister à une pression interne sensible sans retournement comprenant une structure unitaire ayant une paroi latérale cylindrique sans soudure (10) et une paroi de fond (18) intégralement formée avec la paroi latérale (10) à son extrémité inférieure, où le rapport de l'épaisseur de ladite paroi de fond (18) à l'épaisseur de ladite paroi latérale (10) ne dépasse par 3,0, ladite paroi de fond (18) comprenant des surfaces s'effilant s'étendant vers le bas à partir de la paroi latérale (10), lesdites surfaces s'effilant formant un angle de conicité entre 1,3° et environ 2,2° et un effilement de paroi en épaisseur de 0,01524 cm (0,006 pouce) à environ 0,0254 cm (0,010 pouce) en excès de la paroi latérale (10), une surface tronconique externe (11) s'étendant vers le bas et vers l'intérieur de ladite paroi latérale (10) vers l'axe dudit récipient, ladite surface tronconique externe formant un angle au fond entre 35° et environ 45° par rapport à l'axe du récipient (17), un rayon de fond intégralement connecté à ladite surface tronconique externe (11) formant une surface annulaire de support (15) du récipient, ladite surface annulaire de support (15) ayant un diamètre compris entre 5,207 cm (2,05 pouces) et environ 5,588 cm (2,2 pouces), une surface tronconique interne (13) intégralement connectée audit rayon de fond et s'étendant vers le haut et vers l'intérieur de ladite surface annulaire de support (15) vers l'axe du récipient, ladite surface tronconique interne (13) formant un angle de 12°±4° par rapport à l'axe du récipient, la hauteur de ladite surface tronconique interne (13) étant plus faible que la moitié de la hauteur de ladite surface tronconique externe (11) et un panneau central concave vers le bas (12) intégralement connecté à ladite surface tronconique interne (13) et s'étendant vers le haut et vers l'intérieur de ladite surface tronconique interne (13) jusqu'à l'axe dudit récipient (17), le rayon de courbure dudit panneau central concave vers le bas (12) étant entre environ 5,715 cm (2,250 pouces) et environ 7,62 cm (3,000 pouces), ledit panneau central (12) s'étendant, à sa partie la plus haute, légèrement au-delà de la hauteur de ladite surface externe tronconique (11).

2. Récipient selon la revendication 1, où la paroi latérale cylindrique (10) a une épaisseur comprise entre 0,008636 cm (0,0034 pouce) et environ 0,01397 cm (0,0055 pouce).

3. Récipient en alliage léger à base d'aluminium (17) capable de résister à une pression interne sensible sans retournement comprenant un structure unitaire ayant une paroi latérale cylindrique sans soudure (10) et une paroi de fond (18) intégralement formée avec ladite paroi latérale (10) à son extrémité inférieure, où le rapport de l'épaisseur de ladite paroi de fond (18) à l'épaisseur de ladite paroi latérale (10) est de 3,0, ladite paroi de fond (18) comprenant des surfaces s'effiliant qui s'étendent vers le bas à partir de la paroi latérale (10), lesdites surfaces formant un angle de conicité de 2° et un effilement de paroi en épaisseur de 0,02286 cm (0,009 pouce) en excès de ladite paroi latérale (10), une surface tronconique externe (11) s'étendant vers le bas et vers l'intérieur de ladite paroi latérale (10) vers l'axe dudit récipient (17), ladite surface tronconique externe (11) formant un angle au fond de 40° par rapport à l'axe du récipient (17), un rayon de fond intégralement connecté à ladite surface tronconique externe (11) formant une surface annulaire de support (15) pour le récipient, une surface tronconique

interne (13) intégralement connectée audit rayon de fond et s'étendant vers le haut et vers l'intérieur de ladite surface annulaire de support (15) vers l'axe du récipient, ladite surface tronconique interne (13) formant un angle de 12° par rapport à l'axe du récipient, la hauteur de ladite surface tronconique interne (13) étant plus faible que la moitié de la hauteur de ladite surface tronconique externe (11), et un panneau central concave vers le bas (12) intégralement connecté à ladite surface tronconique interne (13) et s'étendant vers le haut et vers l'intérieur de ladite surface tronconique interne (13) jusqu'à l'axe dudit récipient, le rayon de courbure dudit panneau central convave vers le bas (12) étant plus grand que le diamètre de la surface annulaire de support (15), le rapport du rayon de courbure à la moitié du diamètre de la surface annulaire de support (15) étant d'environ 2,2, ledit panneau central (12) s'étendant, à sa partie la plus haute, légèrement au-delà de la hauteur de ladite surface tronconique (15).

4. Récipient selon l'une quelconque des revendications 1, 2 ou 3, où l'épaisseur de ladite paroi latérale (10) dudit récipient est de l'ordre de 0,012446 cm (0,0049 pouce)±0,001016 cm (0,0004 pouce) et l'épaisseur du panneau central (12) est de l'ordre de 0,03429 cm (0,0135 pouce).

5. Récipient selon l'une quelconque des revendications précédentes, où le diamètre de la surface annulaire de support (15) du récipient est d'environ 5,461 cm (2,150 pouces).

6. Récipient selon l'une quelconque des revendications 1, 2, 3 ou 4, où le diamètre de la surface annulaire de support (15) du récipient est d'environ 5,334 cm (2,100 pouces).

7. Récipient selon l'une quelconque des revendications précédentes, comprenant un diamètre de corps d'environ 6,604 cm (2,600 pouces).

8. Récipient selon l'une quelconque des revendications précédentes, où le rayon de courbure du panneau central concave vers le bas (12) est d'environ 5,969 cm (2,350 pouces).

9. Récipient selon l'une quelconque des revendications précédentes, où l'alliage à base d'aluminium est 3004 H-19.

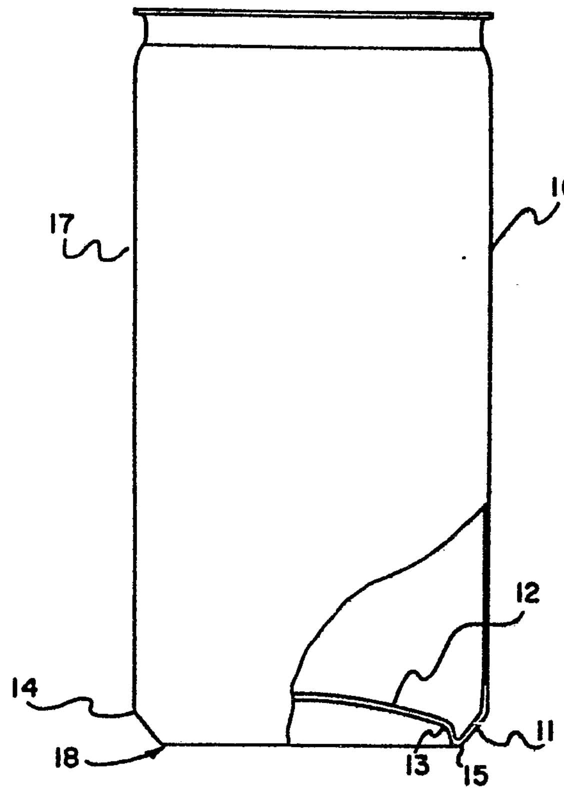

FIG. 1

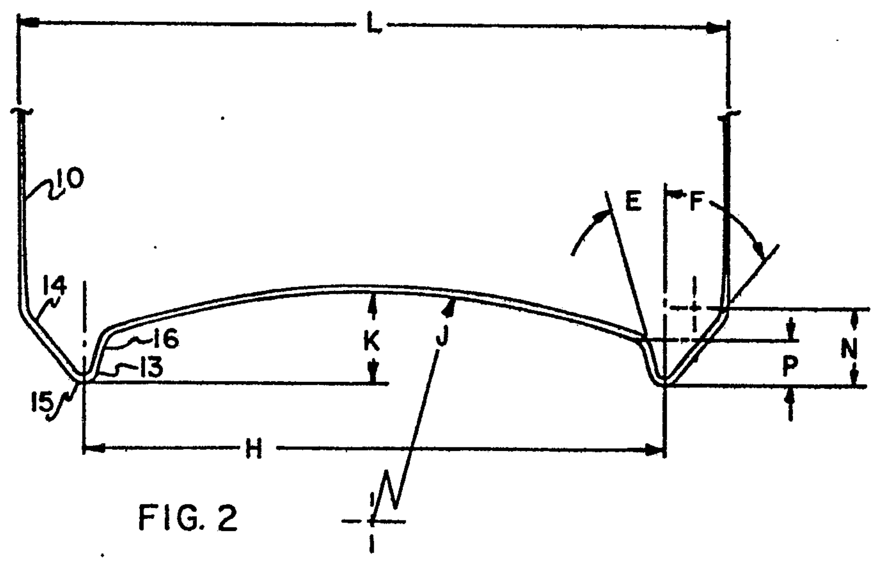

FIG. 2

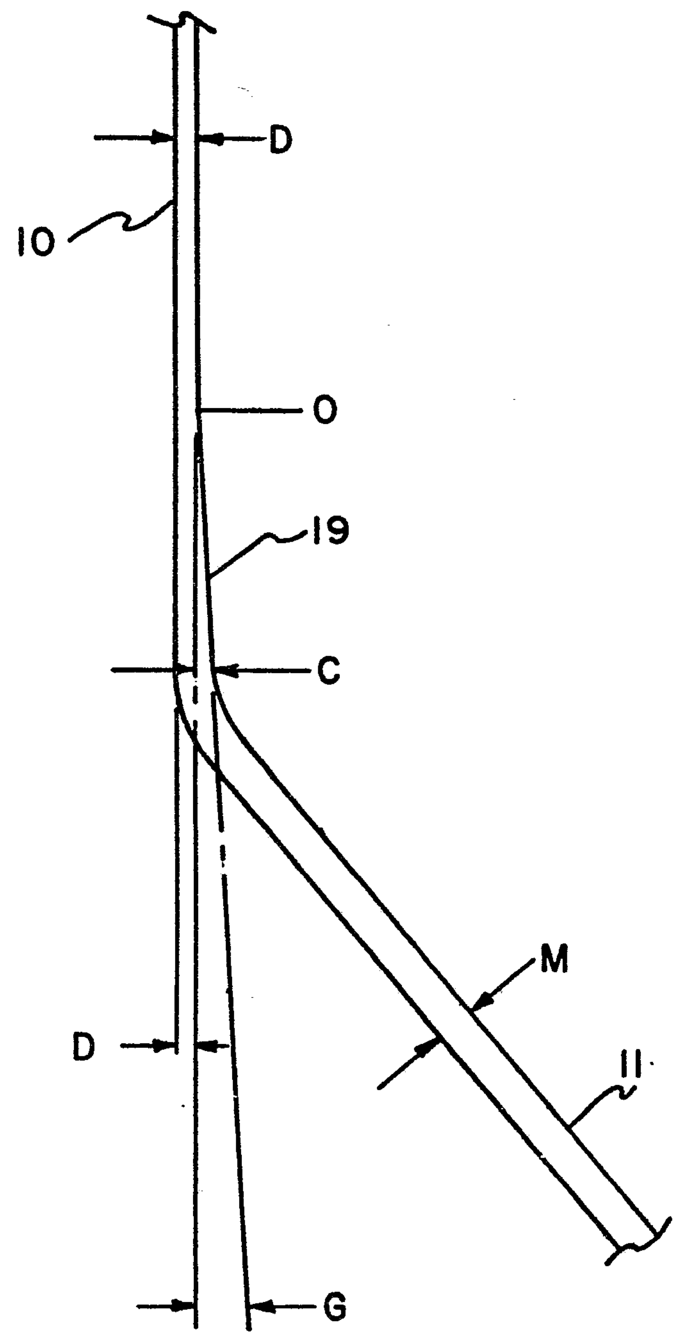

FIG. 3