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1593855

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(54) CONTAINERS

(71) We, METAL BOX LIMITED, of Queens House, Forbury Road, Reading RG1 3JH, Berkshire, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to containers having a tubular side wall and closed at one end by an end wall integral with the side wall and more particularly but not exclusively to can bodies drawn from sheet metal, such as are used for beer and other substances under pressure in which the side wall thickness may be equal or smaller than the end wall thickness depending on the particular container application requirement.

In a known container for butane the container comprises a can end having a concave closure panel joined by a double seam to the container body. The body is drawn from tinplate to have a cylindrical side wall integral with a convex bottom. The convex bottom comprises a closure panel of arcuate cross section which is surrounded by an annular portion of arcuate cross section which has a relatively small radius and joins the gentle curve of the closure panel to the cylindrical side wall. A concave dimple is provided, in the centre of the convex bottom, for use when the valve of a gas appliance is fitted to the container. Whilst it is possible to stand this container on the annular periphery of the concave dimple, it is not stable enough for ordinary conveying and stacking because the diameter of the dimple is too small and the curvature of the convex bottom is too great. An attempt to overcome these problems is described in United States Patent No. 3,904,069 wherein the frusto spherical bottom of the butane container is replaced by bottom profiles comprising a central concave portion having a diameter about 60% of the container diameter, and surrounded by concentric annular frustoconical portions joined to the side wall. Accordingly any increase in the internal pressure within the can causes the bottom to distend outwardly. As the can height grows the container is able to stand on the periphery of the concave central portion. However, the concave portion encroaches upon the container volume and the hard chime junctions between the concave portion and the surrounding annular portions disturb the distribution of stress within the material of the bottom.

This invention provides a container body having a tubular sidewall and an end wall integral therewith, the end wall being joined to the side wall at the periphery of an outwardly convex annular portion, of the end wall, having a cross section in the shape of a segment of an ellipse, the end wall being flexible and having means formed therein on which the body may stand upright despite internal pressure.

In one embodiment the outwardly convex annular portion surrounds a substantially flat central panel which in a preferred embodiment has a diameter less than 60% of the diameter of the end wall. The central panel may if desired be held inwards of the annulus by a frusto conical portion. In another embodiment the outwardly convex annular portion surrounds a central panel portion having a cross section in the shape of a segment of an ellipse continuous with the elliptical section of the annular portion.

The means to hold the container body upright may be at least three dimples substantially equispaced around and extending from the annular portion or the central panel.

In another aspect the invention provides container having bodies according to the first aspect and closed by means of a can end.

Various embodiments will now be described, by way of example and with reference to the accompanying drawings in which:—

Fig. 1 is a side elevation of a prior art cylindrical can body sectioned on a diameter;

Fig. 2 is a like view of a first embodiment adapted for containing high pressures;

Fig. 3 is a like view of a second embodiment adapted for containing intermediate pressures;

Fig. 4 is a like view of a third embodiment of a can showing the movement of the bottom under pressure:

Fig. 5 is a perspective view of the can of Fig. 4;

Fig. 6 is a graph of centre panel deflection against the internal pressure derived from tests on the can of Figs. 4 and 5;

Fig. 7 is a side elevation of a fourth embodiment showing supporting dimples located near the side wall;

Fig. 8 is a side elevation of a fifth embodiment sectioned in a diameter to show the bottom deflection under pressure;

Fig. 9 is a like view of a substantially flat bottomed can for low pressure contents;

Fig. 10a to d depict the progressive buckling of a flat bottomed can by an increasing internal pressure; and

Fig. 10e is a sectioned side elevation of a container having an elliptical bottom panel.

Fig. 10a shows part of a can drawn from sheet metal and having a cylindrical side wall 1 and a flat bottom 2. When such a can is subjected to a moderate internal pressure, the initial shape of the base, denoted by the dashed line 3 in Fig. 10b is deformed to a convex form denoted by the dashed line 4 and may relax, when the pressure is relieved, to the shape shown by the full line 5 which it will retain. While under pressure the centre of the bottom 2 is under the influence of radial and tangential tensile stresses while the peripheral area 6, which joins the centre to the side wall, is under tangential compressive stress and radial tensile stress. The cylindrical side wall 1 is under circumferential and axial tensile stress. Therefore, under high pressure the compressive stress in the bottom predominates and the peripheral area buckles locally as denoted 7 in Figs. 10c and 10d. Most of the bottom area however is not buckled, but deformed permanently to the bulged shape shown in Fig. 10c. It is therefore apparent that the peripheral area of the bottom 2 requires a shape capable of preventing buckling,

One prior art solution to the problem is shown in Fig. 1 in which a can 8 is shown which has a cylindrical side wall 9 and a hemispherical bottom 10. Whilst the hemispherical bottom 10 has ideal pressure retaining properties it necessitates the provision of a support ring 11 to enable the can to stand upright for conveying and filling. However, the hemispherical end 10 is wasteful of space when the cans are packed in bulk for distribution and the support ring adds significantly to the cost of the can and is therefore only applicable for high pressure containers such as aerosol cans. Although it is possible to provide support dimples spaced evenly near the lowest part of the sphere at comparatively small pitch diameter they could not adequately provide the required stable support.

We have found that useful cans may be drawn from sheet metal, such as tinplate or aluminium, to have a bottom profile having a cross sectional shape in the form of a semi ellipse. Such a can is depicted in Fig. 10e. The bottom 12 is shown unpressurised by the full line and the pressurised shape is indicated by the dashed line 13. In Fig. 10e the major axis of the elliptical cross section of the bottom 12 lies diametrically across the cylindrical side wall 14 so that the can is not excessively elongated; as would be the case if the minor axis of an ellipse was arranged to lie drammatically or if a hemispherical end had been used.

From the foregoing explanation of buckling it will be understood that it is not necessary to continue the ellipsoidal profile all the way across the bottom and in the embodiment of Fig. 2 a can 15 is shown in which the bottom has an annular portion 16 having the cross section of a convex segment of an ellipse and a substantially flat central panel 17 around which there are a plurality of dimples on which the can may stand. The notional other half of the ellipse is shown dashed to show the difference. However, in Fig. 2 the ratio of the major axis to the minor axis of the ellipse is about 2:1, this relatively deep ellipsoidal ratio being suitable for moderate internal pressures of the order of 100 p.s.i. when made from 0.0083 inch thick tinplate material. This is in contrast to the can bottom 18 of Fig. 3, in which the ratio of major axis to minor axis of the ellipse is of the order 4:1, this shallow can bottom 18 having a flat central panel 19 being suitable for low internal pressures of the order of 40 p.s.i. if made from similar material. Again the notional other half of the elliptical curve is shown dashed to show the difference. Clearly the can bottoms of Figs. 2 and 3 could allow the cans to stand upright on the flat central portions (17, 19) when empty but the deflection of the bottom under pressure, when filled and closed, would make them unstable. Therefore at least three dimples 20 are provided in spaced angular relationship around the periphery of the flat centre panels (17, 19) to enable the can to stand upright.

The flat centre panel 17, of the moderate pressure can body 15 of Fig. 2, has a diameter "d" which is a little over half the overall diameter of the can body 15. In contrast the flat central panel 19 of Fig. 3 for the low pressure can body, if made from 0.0083 inch thick material such as tinplate, or for the high pressure if made from tinplate 0.0120 inch thick, has a somewhat larger diameter D. The diameter of the flat central panel is chosen having regard for the material thickness and for the pressure which the can is to contain when closed and in the case of pressurised cans will not generally exceed 60% of the overall can diameter.

Figures 4 and 5 show a can body 21

suitable for carbonated beverages when closed by a known can end which is not shown. The can body 21 was drawn from tinplate 0.0083 inches thick into a cup which was subsequently wall ironed so that the body comprises a side wall 22 which is 0.00028 inches thick and a bottom 23 which is 0.0083 inches thick. The bottom has an annular portion 24, the cross section of which is a portion of an ellipse, which joins the side wall 22 to a flat central panel 25 depicted in the unpressurised shape by a dashed line. The full line 25A shows the shape to which the bottom deflects under pressure.

Fig. 6 is a graph of the centre panel deflection in inches, marked "L" in Fig. 4, plotted against the internal pressure in pounds per square inch causing the deflection. Normally the pressure in a can of carbonated beverages will not exceed 110 p.s.i. and at this pressure the central panel deflection is 0.075 inches.

Fig. 6 further shows that some of the deflection arising during increase in pressure is retained after the pressure within the container is reduced. The residual deflection is about 0.020". In fact the centre panel is deformed under pressure to approximately an ellipsoidal surface, which is desirable.

Referring to Fig. 4 it will be understood that provided that the height of the supporting dimples 20 is greater than the deflection of the centre panel the can will be able to stand upright on the dimples not only when empty but also when under pressure. This is because the maximum deflection arises at the middle of the centre panel, the movement of the dimples denoted "M" and supporting annular portion, denoted "N" is less than the maximum.

In Fig. 5 the supporting dimples 20 can be seen to be evenly arranged adjacent to and within the periphery of the flat centre panel 25. However as the flat centre panel, of bodies for moderate pressures, is relatively small in diameter the dimples are in a pitch circle of small diameter. Therefore it may be preferable to locate the dimples in the surrounding annular portion to increase the stability of the can.

Fig. 7 shows such a can 28 in which the dimples 26 are formed in the annular portion of the bottom near to the side wall 27. The dimples 26 are somewhat longer than the dimples 20 of Figs. 2, 3 and 4, in order to compensate for the fact they do not deflect with the base when it is under pressure.

In Fig. 8 a can 29 has a side wall 30 integral with a bottom 31 which comprises a centre panel 32 having a plurality of support dimples 33 and surrounded by a frusto conical portion 34 which joins the centre panel to an annular portion 35 having a cross section which is a segment of an ellipse so as to join the frusto conical portion 34 to the side wall 30 of the container 29. The dashed line denoted *31A* shows the shape of the bottom 31 when deflected under pressure into a substantially ellipsoid form. In the unpressurised condition the can rests upon the annular portion 35 and is therefore well able to withstand the axial forces arising in known double seaming machine which are used to fix the can end after filling. When under pressure the can rests upon the support dimples 33.

Fig. 9 shows a can 36 suitable for thermally processed or other foods. As the pressures arising during thermal processing are relatively low the flat central panel 37 extends nearly the full width of the body to which it is joined by the small annular portion 38. The cross section of the annular portion 38 is a segment of an ellipse so that as the flat panel deflects under processing pressures the annular portion resists buckling and provides support for the deflected convex form of the central panel 37. As in the previous examples described dimples 20 are provided to enable the can to stand upright.

Cans according to the invention may be drawn from sheet metals such as tinplate or aluminium. If the cans are deep drawn, the sheet from which they are drawn may be decorated with lacquers or print. If however the cans are manufactured by drawing followed by wall ironing, decoration may be applied to the formed cans.

Whilst the invention has been described with reference to metal containers, containers made from plastics materials such as acrylonitrite-butadiene-styrene of polyvinylchloride may also be used.

WHAT WE CLAIM IS:—

1. A container body having a tubular side wall and an end wall integral therewith, the end wall being joined to the side wall at the periphery of an outwardly annular portion, of the end wall, having a cross section in the shape of a segment of an ellipse, the end wall being flexible and having means formed therein on which the body may stand upright despite internal pressure.

2. A container body according to claim 1 wherein the outwardly convex annular portion surrounds a substantially flat central panel.

3. A container body according to claim 2 wherein the diameter of the substantially flat central panel is less than 60% of the diameter of the end wall.

4. A container body according to claim 1 wherein the outwardly convex annular portion surround an outwardly convex central panel having a cross section in the shape of a segment of an ellipse continuous with the elliptical section of the annular portion.

5. A container body according to any preceding claim wherein the means to hold

the body upright is at least three dimples substantially equispaced around and extending outwardly from the annular portion of the end wall.

6. A container body according to any of claims 2 to 4 wherein the means to hold the body upright is at least three dimples substantially equispaced around and extending outwardly from the central panel.

7. A container body according to claim 6 when dependant on claim 3 or claim 2, wherein a frusto conical portion extends axially and inwardly from the outwardly convex annular portion to hold the central panel inwards of the annular portion when the can is empty and permit eversion of the central panel when the body is subjected to internal pressure so that the can may stand upon the dimples.

8. A container body according to any preceding claim when closed by a can end.

9. A container body, substantially as hereinbefore described with reference to any of figures 2, 3, 4, 5, 6, 7, 8 or 9 of the accompanying drawings.

J. WENDON,
Chartered Patent Agent.

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1593855 COMPLETE SPECIFICATION

5 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 1

FIG. 1

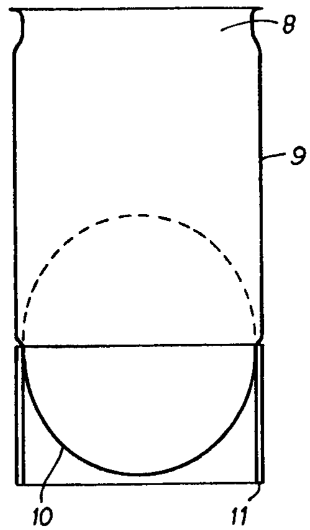


FIG. 2

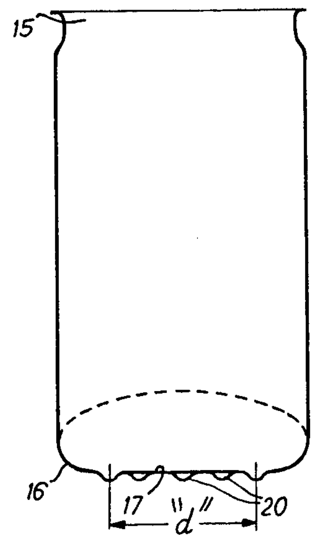
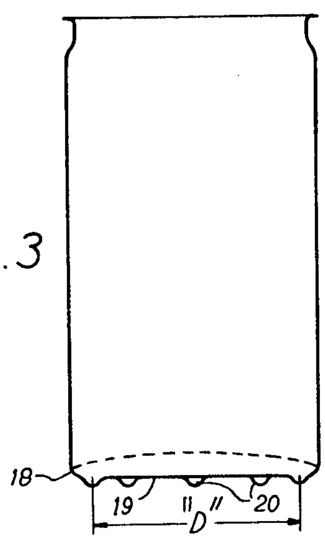


FIG. 3



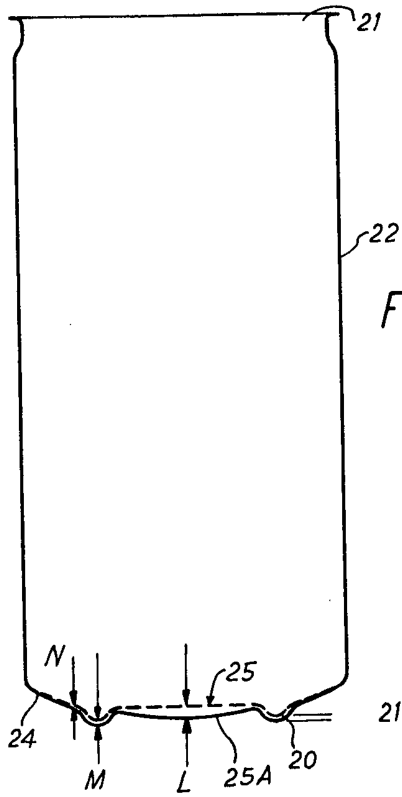


FIG. 4

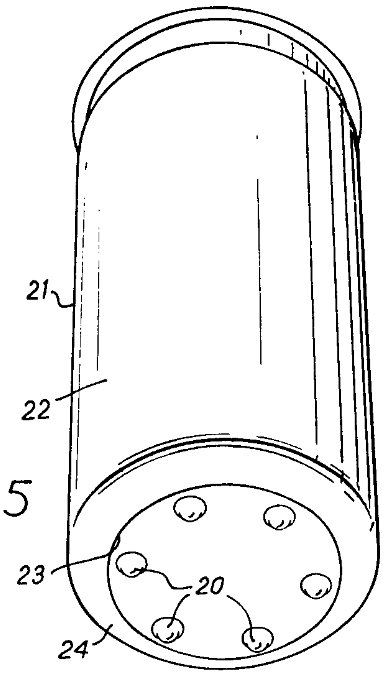


FIG. 5

FIG. 6

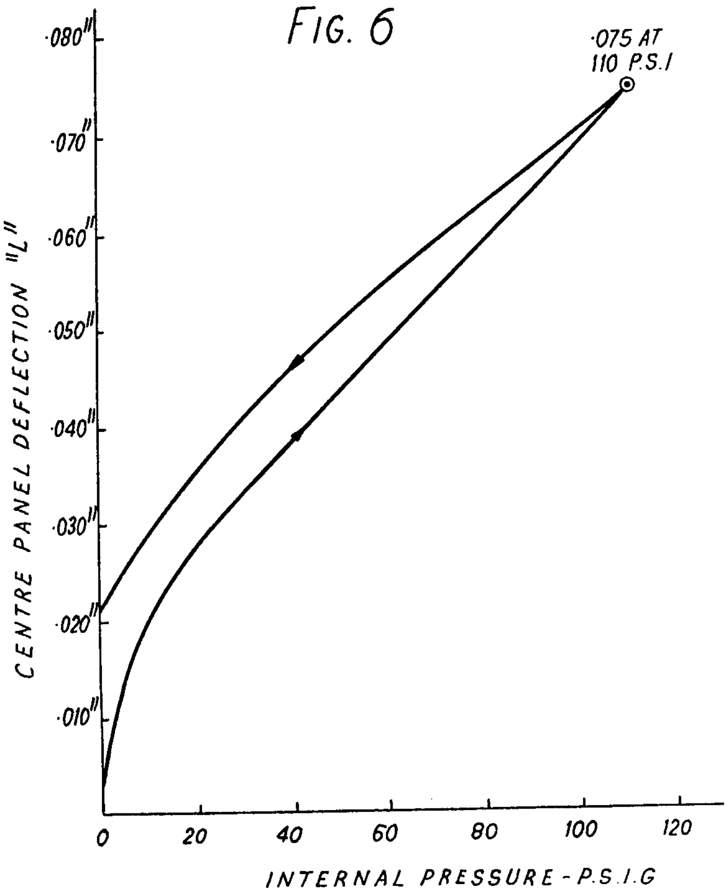

·080"
·070"
·060"
·050"
·040"
·030"
·020"
·010"
CENTRE PANEL DEFLECTION "L"
·075 AT
110 P.S.I
0
20
40
60
80
100
120
INTERNAL PRESSURE - P.S.I.G

FIG. 7

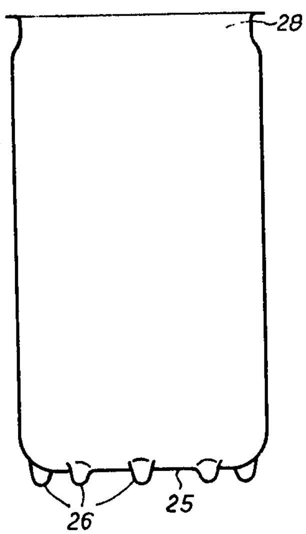
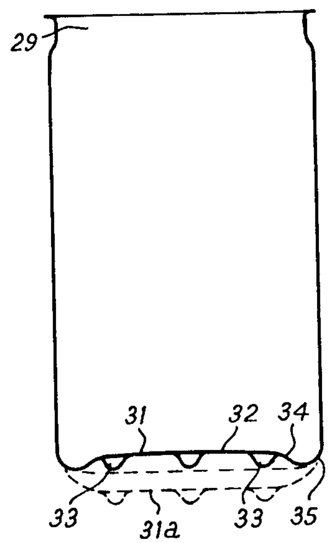


FIG. 8



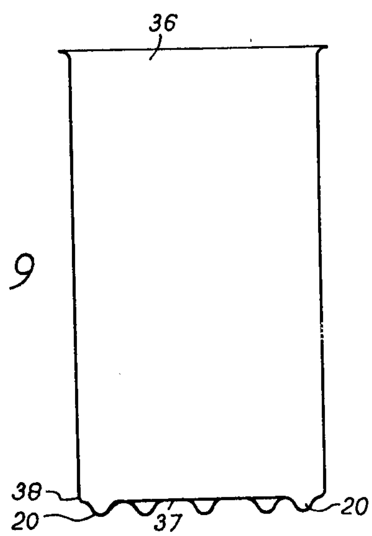


FIG. 9

1593855 COMPLETE SPECIFICATION

5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 5

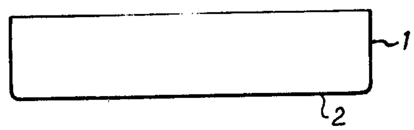


FIG. 10a

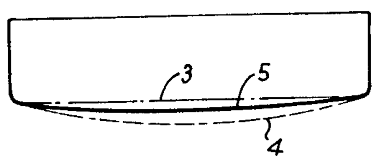


FIG. 10b

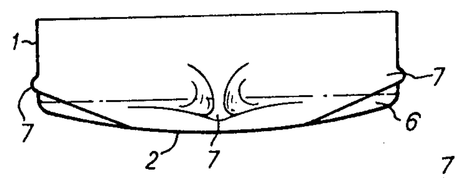


FIG. 10c

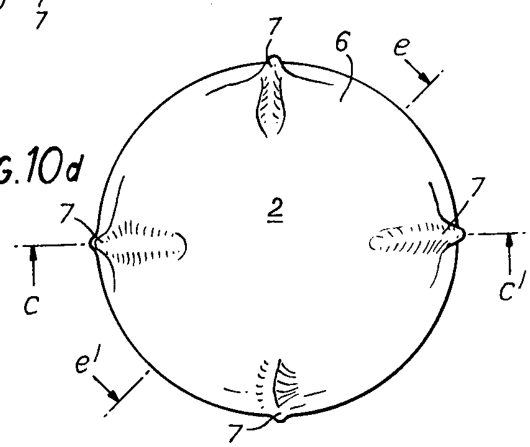


FIG. 10d

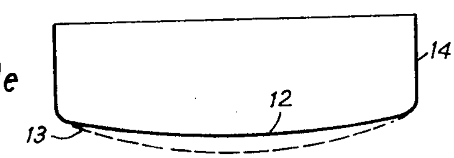


FIG. 10e