

RIB FOR PLASTIC CONTAINER

RTMP'S (97)

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10 The present invention pertains to plastic
containers for beverages, particularly carbonated soft
drink products and the like. More specifically, the
invention relates to a blow molded plastic container
whose shoulder portion comprises as an integral part
thereof, a plurality of rib-like protrusions. These
rib-like protrusions, which are outwardly-extending, are
15 configured using multiple radii of curvature such that
they may be successfully incorporated into even thin
wall shoulder portions of the type found in commonplace
non-returnable containers, and will furthermore remain
intact even when such containers are under internal
20 pressurization. The protrusions subject of the instant
invention have the practical effect of lending improved
grip and manual handling characteristics to the
container, as well as providing mechanical reinforcement
to the shoulder portion.

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30 The use of plastic containers to package
beverages, especially carbonated soft drink products,
has been remarkably successful since such containers
were first introduced in the 1970s. The widescale
application of these containers stems primarily from the
fact that the plastic material from which they are made,

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1 which materials are invariably thermoplastics, most
especially polyesters such as polyethylene terephthalate
(PET), can be biaxially oriented. Biaxial orientation
involves aligning the polymer chains in two directions,
5 the consequence being closer, more orderly packing of
material. The practical benefits of this phenomenon are
two fold: first, containers thus oriented can be
produced with thin walls, often as a direct result of
the orienting process itself; secondly, the mechanical
10 strength and gas barrier properties of these thin-wall
containers increases dramatically upon biaxial
orientation. The overall result is a container that is
light weight, yet extremely robust.

While it is known to fabricate biaxially oriented
15 containers in any number of ways, the most commercially
important are those which employ stretch blow molding
techniques. These techniques generally utilize a
preform or parison, typically produced by way of
injection molding, which is heated, or cooled as the
20 case may be, to at or near the glass transition
temperature of the material. When at this temperature,
the preform is placed into a blow mold wherein it is
stretched longitudinally by a stretch rod and expanded
horizontally by air or other operating gas pressure.
25 The product is a container whose body and shoulder
portions have relatively thin walls and are biaxially
oriented.

Although the thin wall construction of biaxially-
oriented containers is advantageous overall, there are,
30 nevertheless, certain drawbacks to the same. For
example, the thin nature of the wall manifests little,
if any, tolerance for a topographical configuration that

1 is other than smooth, uniform and continuous. Thus even
though it may be desirable to provide alterations or
embellishments to the wall, it has been difficult, if
not impossible, to do so without adversely affecting the
5 mechanical integrity of the same, especially where the
container is under conditions of stress, such as caused
by the internal pressurization associated with the
packaging of carbonated soft drinks.

Of the efforts made in this regard are those
10 directed to placing inwardly directed ridges or ribs in
the shoulder portion of such containers in order to
improve grip and the consumer's ability to hold and
handle the container. Despite the benefits such a
feature would offer, it has not been possible to
15 implement the same in a practical manner, much less a
commercially acceptable one, in thin wall non-returnable
containers. The attempts made in this regard have
generally relied upon an inward rib configuration having
but one radius of curvature, which type of configuration
20 has typically resulted in a container having areas of
unusually high stress at juncture points between the rib
or ridge and the shoulder portion, which circumstance,
under conditions of internal pressurization, can lead to
container failure. More commonly, however, these
25 attempts have resulted in ribs or ridges that evert,
distort or deform, either in whole or in part, under
conditions of internal pressurization.

The art thus recognizes a continuing need to
develop a convenient and practical design for a rib-like
30 protrusion which will not detract from the mechanical
integrity of the container and will remain physically
and visually intact upon pressurization.

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The present invention overcomes the problems heretofore associated with attempts to provide ribs or
5 ridges on the shoulder portion of thin wall, non-returnable plastic containers. In accordance with the invention, rib-like protrusions are provided in the shoulder portion using multiple radii of curvature having a specifically defined relationship. The rib-
10 like protrusions, when implemented pursuant to the invention, do not adversely affect the mechanical strength or integrity of the shoulder wall, nor do they evert, distort or otherwise deform under conditions of use, including internal pressurization.

15 In accordance with the invention, there is provided a blow molded plastic container having a neck portion adapted to receive a closure; a shoulder portion; a body portion; and a bottom portion; the shoulder portion has along at least part of the length
20 thereof, a plurality of upwardly directed rib-like protrusions wherein each protrusion, in axial cross-section, has a first transition portion, a central portion and a second transition portion, all of which are connected in series. The first transition portion
25 is concave outwardly and has a substantially uniform radius of curvature, R_1 ; the central portion is concave inwardly and has a substantially uniform radius of curvature, R_2 ; and the second transition portion is concave outwardly and has a substantially uniform radius
30 of curvature R_3 .

In the practice of the present invention, R_1 and R_3 are substantially the same and are greater than R_2 .

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1 In a preferred mode, R_1 and R_3 are substantially the
same and are about 7 to 9 times greater than R_2 ; more
preferably R_1 and R_3 are about 7.5 to 8.5 times greater
than R_2 ; still more preferably they are about 8.0 times
5 greater than R_2 .

In one embodiment of the present invention, R_1
and R_3 are each independently about 6.30 mm to about
6.40 mm, and R_2 is about 0.74 mm to about 0.84 mm. In a
preferred aspect of this embodiment, R_1 and R_3 are each
10 independently about 6.35 mm and R_2 is about 0.79 mm.

Geometrically, while the upwardly directed rib-
like protrusions may be straight and oriented either
vertically or at an angle, other patterns may be
employed. Thus in one embodiment of the invention the
15 rib-like protrusion are oriented in the form of an
upwardly directed spiral or like configuration. In a
preferred aspect of this embodiment, the spiral is
configured such that the rib-like protrusions diverge
from one another as they proceed down the length of the
20 shoulder portion toward the body portion.

While the number of rib-like protrusions may
vary, it is preferred that they be spaced apart from one
another. As will be appreciated by those of skill in
the art in this regard, it is preferred if the rib-like
25 protrusions are equidistant, one from the other; the
spacing apart between adjoining protrusions in this
situation is conveniently measured by angle α , which
bisects the central portion of adjoining protrusions and
has, as its point of origin, the longitudinal axis of
30 the container. In a particularly preferred embodiment,
angle α is approximately 25.7° , resulting in fourteen

1 rib-like protrusions being circumferentially disposed
equidistant about the shoulder portion of the container.

While for purposes of the invention, the rib-like
protrusions need extend along only a part of the length
5 of the shoulder portion, it is preferable if they extend
along substantially the entire length of said shoulder
portion. While the length of said shoulder portion can
vary depending upon the size and other conformational
characteristics of the container, it is generally equal
10 to about 30% of the total height of the container.

In the circumstance where the rib-like
protrusions are spaced apart one from the other, and in
the particular embodiment wherein they extend along
substantially the entire length of the shoulder portion,
15 it is preferred if the outer surface of said shoulder
portion between each of said spaced apart protrusions is
substantially flat, at least in the circumferential
direction.

In one embodiment of the present invention, the
20 rib-like protrusions are spaced apart equidistant from
one another and extend along substantially the entire
length of the shoulder portion to terminate at or near
that part of the shoulder portion proximate the neck
portion and that part of the shoulder portion proximate
25 the body portion. In this circumstance, the outer
surface of the shoulder portion between the protrusions,
as extant along the entire length of the same, is either
substantially flat or outwardly arcuate in the
circumferential direction.

30 In another aspect of this embodiment, the outer
surface of the shoulder portion proximate the body
portion tapers radially outwardly toward said body

1 portion to form terminal segments. In a preferred
practice, the length of these terminal segments extends
up to about 20%, more preferably about 10 to about 15%,
5 of the length of the shoulder portion as measured from
above said body portion. While these terminal segments
may take any number of configurations, it is preferred
that they be of parabolic shape, the curve or dome of
the parabola being oriented toward the neck portion of
the container.

10 In practice, the present invention can be
successfully implemented in containers having thin wall
shoulder portions. In general, the wall thickness of
shoulder portions contemplated in this regard are from
about 0.22 mm to about 0.35 mm, more typically from
15 about 0.25 mm to about 0.28 mm. As will be appreciated
by those of skill in the art, this magnitude of wall
thickness is commonly employed in non-returnable
beverage containers, also known as one-way or disposable
containers. The present invention need not be limited
20 to such containers however.

Containers of the present invention can further
be fabricated by techniques well known in the art. Of
the more preferable methods in this regard is stretch
blow molding, employing a preform or parison of
25 conventional design and a blow mold wherein that aspect
of the mold corresponding to the shoulder portion of the
container of the invention is configured consistent with
the description provided herein to produce the rib-like
protrusions subject of the present invention. As will
30 be appreciated by those of skill in the art the rib-like
protrusion of the present invention may be implemented
in containers of any size, including without limitation

1 sizes commonly found in commercial use such as from 0.33
liter to 2.0 liter and greater.

While any plastic material suitable for use with
beverages, including soft drink products and the like,
5 may be employed, it is preferred as a practical material
that thermoplastics, more preferably polyesters, be
employed. The most preferred polyester material in this
regard is polyethylene terephthalate, or PET. PET as
contemplated herein includes homopolymer PET and
10 copolymer PET including, without limitation, those
copolymers wherein the ethylene glycol component has
been replaced, in part, with, e.g., cyclohexane
dimethanol; and those wherein the terephthalic acid
component is replaced, in part, with, e.g., isophthalic
15 acid. As those of skill in the art will recognize, the
intrinsic viscosity (IV) of the PET can vary depending
upon considerations of use setting and container
conformation, and is generally greater than about 0.55,
usually greater than about 0.75, and most commonly about
20 0.80 to 1.00.

The foregoing features of the present invention
are illustrated by the drawings and related detail
discussion provided hereinbelow.

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FIGURE 1 is an elevational view of a container of
approximately 1500 ml size having rib-like protrusions
in the shoulder portion as contemplated by the present
invention. The figure illustrates an embodiment of the
30 invention wherein the rib-like protrusions are in the
form of a spiral.

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1 FIGURE 2 is an axial cross-section of the
container illustrated in FIGURE 1 taken along section
line 2-2.

5 FIGURE 3 is a partial enlargement of the cross-
section shown in FIGURE 2 illustrating details of the
rib-like protrusions, including the radii of curvature
employed to configure the same.

10 FIGURE 4 is an elevational view of another
embodiment of the present invention wherein the shoulder
portion of a container of approximately 1500 ml size
further comprises parabolic terminal segments.

 FIGURE 5 is an axial cross-section of the
container illustrated in FIGURE 4 taken along section
line 5-5.

15 FIGURE 6 is a partial enlargement showing the
longitudinal cross-section of the wall of the shoulder
portion of the container illustrated in FIGURE 4 and the
tapering details of the parabolic terminal segments.

20 FIGURE 7 is an elevational view of a container of
approximately 2250 ml size having rib-like protrusions
in the shoulder portion as contemplated by the present
invention. The figure illustrates an embodiment of this
size container wherein the rib-like protrusions are in
the form of a spiral and the shoulder portion further
25 comprises parabolic terminal segments.

30 Referring now to the drawings in detail, there is
shown at FIGURE 1 an embodiment of the present
invention. Depicted thereat is a blow molded plastic
container 10, the container illustrated being of about

1 1500 ml size and having a neck portion adapted to
receive a closure 11, a shoulder portion 12, a body
portion 13, which is generally tubular in shape, and a
bottom portion 14 which may be of either the petaloid or
5 champagne push-up type, petaloid being depicted. As
will be appreciated by those of skill in the art, for
purposes of the present invention the bottom portion may
also be outwardly hemispherical, which normally requires
the conjoint use of a base cup.

10 As shown in FIGURE 1, the shoulder portion has a
plurality of upwardly directed rib-like protrusions 15.
As illustrated in FIGURE 1, these rib-like protrusions
extend along substantially the entire length of shoulder
portion 12, and have termini 16 proximate neck portion
15 11 and termini 17 proximate body portion 13. In FIGURE
1, the rib-like protrusions 15 are in the form of a
spiral, the particular embodiment illustrated showing
the spiral diverging as it proceeds from that part of
the shoulder portion proximate neck portion 11 to that
20 part proximate body portion 13.

Turning now to FIGURE 2, there is shown the axial
cross-section of container 10 taken along section line
2-2. As shown therein, shoulder portion 12 of container
10 embodied at FIGURE 1 has fourteen rib-like
25 protrusions 15. Each of said protrusions, as shown in
the axial cross-section of FIGURE 2, has a first
transition portion 19, which is concave outwardly and is
connected to a central portion 20, which is concave
inwardly. Central portion 20 is in turn connected to a
30 second transition portion 21 which is concave outwardly.
The details of this configuration and the multiple radii

1 employed in forming rib-like protrusion 15 are shown at
FIGURE 3.

As illustrated in FIGURE 3, first transition
portion 19 has a substantially uniform radius of
5 curvature R_1 . As further seen in FIGURE 3, the
outwardly concave first transition portion inflects at
central portion 20, this central portion being inwardly
concave and having a substantially uniform radius of
curvature R_2 . To complete the configuration of
10 protrusion 15, the central portion 20 inflects to form
the second transition portion 21, which is concave
outwardly and has a substantially uniform radius of
curvature R_3 . In the container depicted at FIGURE 3,
radii of curvature R_1 and R_3 are substantially the same
15 and are approximately eight times greater than radius of
curvature R_2 .

In the embodiment depicted at FIGURES 1, 2 and 3,
rib-like projections 15 are circumferentially disposed
equidistant about shoulder portion 12. As shown in
20 FIGURE 3, protrusions 15 are spaced apart and separated
from one another by angle α , which bisects the central
portions 20 of adjoining protrusions and has its point
of origin at the longitudinal axis of container 10.
Also depicted in FIGURES 1, 2 and 3 is a preferred
25 embodiment of container 10 wherein the outer surface of
the shoulder portion 18 between each of protrusions 15
is substantially flat in the circumferential direction.

Referring now to FIGURE 4 there is shown another
embodiment of the present invention wherein rib-like
30 protrusions 15 of shoulder portion 12 further comprises
parabolic terminal segments 22. As illustrated, the
length of these terminal segments, designated ℓ , extends

1 along the shoulder portion 12 above body portion 13. In
practice, length ℓ can be about 20% of the total length
s of shoulder portion 12. In the illustration, ℓ is
5 approximately 12% of length s, which in turn is
approximately 30% of height h of container 10.

In the container depicted at FIGURE 4, the outer
surface of the shoulder portion 18 between rib-like
protrusions 15 is flat in the circumferential direction,
which can be seen by further reference to FIGURE 5 which
10 is an axial cross-section taken along section line 5-5
in FIGURE 4. In the embodiment illustrated, terminal
segments 22 taper outward toward body portion 13 along
substantially the entire length ℓ of said segments, as
illustrated in detail at FIGURE 6.

15 The container illustrated at FIGURE 7 depicts the
rib-like protrusions 15 of the present invention
oriented in divergent spiral form on the shoulder
portion 12 of container 23 which is of about 2250 ml
size. The shoulder portion, as shown, further comprises
20 parabolic terminal segments 22 and circumferentially
flat surfaces 18 between said protrusions. In the
embodiment illustrated, the length ℓ of terminal
segments 22 is about 12% of the length, s, of shoulder
portion 12. Length s, as depicted, is approximately 30%
25 of the container height.

It is to be understood that the invention is not
limited to the illustrations and other description
provided herein, which are offered merely to exemplify
the present invention.

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1 WHAT IS CLAIMED IS:

1. A blow molded plastic container which comprises a neck portion adapted to receive a closure; a
5 shoulder portion; a body portion; and a bottom portion, said shoulder portion having along at least a part of the length thereof a plurality of upwardly directed rib-like protrusions, each protrusion in axial cross-section having a first transition portion, a central portion and
10 a second transition portion connected in series, said first transition portion being concave outwardly and having a substantially uniform radius of curvature R_1 , said central portion being concave inwardly and having a substantially uniform radius of curvature R_2 , and said
15 second transition portion being concave outwardly and having a substantially uniform radius of curvature R_3 wherein R_1 and R_3 are substantially the same and are greater than R_2 .

2. The container of Claim 1 wherein R_1 and R_3
20 are substantially the same and are about 7 to 9 times greater than R_2 .

3. The container of Claim 2 wherein R_1 and R_3 are substantially the same and are about 7.5 to about 8.5 times greater than R_2 .

25 4. The container of Claim 3 wherein R_1 and R_3 are substantially the same and are about 8.0 times greater than R_2 .

5. The container of Claim 1 wherein R_1 and R_3 are each independently about 6.30 mm to about 6.40 mm
30 and R_2 is about 0.74 to about 0.84 mm.



1 6. The container of Claim 5 wherein R_1 and R_2 are each independently about 6.35 mm and R_2 is about 0.79 mm.

5 7. The container of Claim 1 wherein said rib-like protrusions extend along substantially the entire length of said shoulder portion.

10 8. The container of Claim 7 wherein said rib-like protrusions are spaced apart equidistant from one another, and the outer surface of the shoulder portion between each of spaced apart protrusions is substantially flat in the circumferential direction.

15 9. The container of Claim 8 wherein said shoulder portion further comprises terminal segments disposed about the circumference thereof, said terminal segments being located between said rib-like protrusions and extending up to about 20% of the length of said shoulder portion above said body portion, said terminal segments being defined by a radially outward tapering of the outer wall surface of said shoulder portion, said outward tapering being in the direction of said body portion.

20 10. The container of Claim 9 wherein said terminal segments are of substantially parabolic shape, the curve thereof being oriented toward said neck portion.

25 11. The container of Claim 10 wherein said terminal segments extend up to about 10 to about 15% of the length of said shoulder portion above said body portion.

30 12. The container of Claim 1 wherein said rib-like protrusions are oriented in the form of a spiral.



1 13. The container of Claim 12 wherein the spiral
is configured such that as said protrusions proceed down
the length of said shoulder portion toward said body
portion, the rib-like protrusions continuously diverge
5 from one another.

14. The container of Claim 1 wherein said
shoulder portion has fourteen rib-like protrusions.

15. The container of Claim 1 wherein said
plastic is a thermoplastic.

10 16. The container of Claim 15 wherein said
thermoplastic is PET.

17. The container of Claim 1 wherein said
shoulder portion has a thickness of about 0.22 mm to
about 0.35 mm.

15 18. The container of Claim 17 wherein said
shoulder portion has a thickness of about 0.25 mm to
about 0.28 mm.

19. A stretch blow molded, PET container which
comprises a neck portion adapted to receive a closure; a
20 semirigid biaxially oriented shoulder portion having a
wall thickness of about 0.22 mm to about 0.35 mm; a
biaxially oriented tubular body portion; and a bottom
portion, said shoulder portion having along
substantially the entire length thereof, a plurality of
25 upwardly directed rib-like protrusions oriented in the
form of a spiral, said rib-like protrusions being
disposed substantially equidistant from one another
about the circumference of said shoulder portion, each
of said rib-like protrusions in axial cross-section
30 having a first transition portion, a central portion and
a second transition portion connected in series, said
first transition portion being concave outwardly and



- 1 having a substantially uniform radius of curvature R_1 ,
said central portion being concave inwardly and having a
substantially uniform radius of curvature R_2 , and said
second transition portion being concave outwardly and
5 having a substantially uniform radius of curvature R_3 ,
wherein R_1 and R_3 are substantially the same and are
about 6.30 mm to about 6.40 mm, and R_2 is about 0.74 mm
to about 0.84 mm.

20. The container of Claim 19 wherein said
10 shoulder portion has fourteen of said rib-like
protrusions and has a wall thickness of about 0.25 mm to
about 0.28 mm.

21. The container of Claim 20 wherein R_1 and R_3
are each independently about 6.35 mm, R_2 is about 0.79
15 mm and the outer surface of said shoulder portion
between each of said rib-like protrusions is
substantially flat in the circumferential direction.

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