(57) Abrégé/Abstract:
Apparatus and methods relate to containers having a sidewall portion with at least one generally vertical corrugation therein. The containers can be of a variety of shapes, sizes, cross-sections, and materials. The corrugation improves the container sidewall strength and resistance to buckling under compressive loads such as stacking of multiple containers.
Abstract of the Disclosure:

Apparatus and methods relate to containers having a sidewall portion with at least one generally vertical corrugation therein. The containers can be of a variety of shapes, sizes, cross-sections, and materials. The corrugation improves the container sidewall strength and resistance to buckling under compressive loads such as stacking of multiple containers.
CONTAINER SIDEWALL APPARATUS AND RELATED METHODS

[1] This invention relates generally to containers, and more specifically to new methods and apparatus for strengthening containers by forming at least one cross-sectional shape or pattern into the container sidewall.

Background of the Invention:

[2] Containers (such as plastic injection-molded buckets or pails or the like) come in a wide variety of shapes and sizes. Commonly, these have generally flat and/or smooth curved sidewalls. Sometimes reinforcing ribs or other features are formed or provided on the exterior and/or interior of the container. In many applications, the containers are designed to be nestable and stackable. When the containers are filled, the stacking loads can be substantial, and the sidewalls typically have to be designed and tested to support and withstand certain threshold requirements (to avoid failure when they are dropped or stacked, etc.).

[3] When sufficient force is exerted downwardly on such containers, the container can collapse or “fail.” Commonly, this failure begins with or includes the weakest point of the container sidewall buckling in or out (toward or away from the inside of the container). Among other situations, such loading and buckling failures can occur when filled containers are stacked too high on each other. Even for unstacked single containers, however, sufficient force can cause such a failure.
[4] It is desirable to provide a container with improved strength and durability to withstand heavy loads (such as imposed by stacking filled containers, or any other kind of force applied downwardly), without bending or crumpling.

5 **Objects and Advantages of the Invention:**

[5] In one aspect of the invention, there is provided a method of storing, including the steps of providing a plurality of containers having a bottom and a sidewall portion extending upwardly therefrom, the sidewall portion including at least one generally vertical corrugation formed therein, filling the containers, closing the containers, and stacking the closed containers together.

[6] In many applications, a plurality of such corrugations will be useful. Among other things, the corrugation strengthens the sidewall and improves its resistance to buckling and other forces, such as may occur when the container is loaded with product or is in a stack of heavy objects (such as similar containers).

[7] Depending on the application, the corrugation can extend across all or some of the height of the sidewall portion of the container. The container or bucket can have any suitable cross-section, including generally circular, generally rectangular, square, etc. The specific cross-section or cross-sections of the corrugation or corrugations can be a wide
variety, depending on the materials from which the container is fabricated and the application for which it is to be used.

[8] A container and lid combination of the aforementioned character can be provided as can a plurality of such containers in a stacked arrangement.

[9] With the described containers, it may be possible to reduce the amount of material required to form a wall having a given strength, so that lighter-weight walls are able to carry greater loads, with less material being required to provide a container of a given “strength”, etc. Among other things, the described containers may be used for transporting materials and things. In such applications, the container itself is simply added weight that must be transported (the thing inside the container typically being the item sought by the end user). Accordingly, by providing sufficient container wall strength with less material, the costs of shipping are reduced because each “thing” in its packaging weighs less. Thus, persons of ordinary skill in the art will understand that the invention is economically and environmentally beneficial.

[10] Other advantages of the invention will be apparent from the following specification and the accompanying drawings, which are for the purpose of illustration only. It is understood that changes in the specific structure shown and described may be made within the scope of the claims without departing from the spirit and scope of the invention.
Brief Description of the Drawings:

[11] FIG. 1 is a perspective view illustrating a preferred embodiment of a container and lid assembly of the invention, for a container having a generally square cross-section;

[12] FIG. 2 is similar to FIG. 1, but shows a partial cutaway of the corner section of the preferred assembly;

[13] FIG. 3 is a sectional view taken along reference line 3-3 of FIG. 2;

[14] FIG. 4 is similar to FIG. 3, but illustrates one of the many alternative embodiments of the present invention, namely, a container with a generally rectangular-shaped cross-section having sidewalls with a fluted or corrugated configuration; and

[15] FIG. 5 is similar to FIGS. 3 and 4, but illustrates yet another of the many alternative embodiments of the present invention, namely, a container with a generally circular-shaped cross-section having sidewalls with a fluted or corrugated configuration.
Description of Preferred Embodiment:

[18] The detailed description herein and in the appended drawings is intended as a description of the presently preferred embodiments of the invention, but is not intended to represent the only forms in which the present invention may be constructed or utilized. The description sets forth a preferred construction and preferred functions of the invention, as well as a preferred sequence of steps for operating the invention in connection with the illustrated embodiments. It is to be understood, however, that the same or equivalent functions and sequences may be accomplished by different embodiments that are also intended to be encompassed within the spirit and scope of the invention and the claims below.

[19] As best illustrated in FIGS. 1-3, and particularly to FIG. 1, the preferred container 10 and a mating lid preferably can be fabricated from any suitably strong, lightweight material (such as plastic, metal, or the like). The container 10 preferably includes a base 12 and a sidewall portion 14 extending upwardly therefrom. A lid 50 preferably is provided to close the top of the container.

[20] Persons of ordinary skill in the art will understand that the general shape and dimensions of the base 12, the sidewall portion 14, and the lid 50 can be configured across a wide useful range, depending on the materials used, the applications for which the container is intended, and other factors. They will likewise understand that the invention can be incorporated into a wide variety of containers having various different methods of engagement between the lid and the container body sidewalls.
[21] One or more corrugations or fluting members 16 (as best shown in FIG. 3) preferably are provided in the sidewall portion 14. Among other things, the corrugations or fluting 16 help strengthen the sidewall portion of the container, and thereby the entire container assembly, against forces in the direction of arrow A in FIG. 1.

[22] The corrugations or fluting members 16 can be shaped and located and sized in a wide variety of ways, and still provide some of the benefits of the invention. They are illustrated in FIGS. 1-3 as a pair of indentations at each corner of a generally square or rectangular container, and as extending substantially the full height of the sidewall 14. Persons of ordinary skill in the art will understand that many factors can be customized to provide a desired balance of strength, weight, and performance for a desired application. These include, by way of example and not by way of limitation, the depth of the indentations, the thickness of the sidewall 14 at those locations, the sharpness of the indentations’ angles with respect to the adjacent sidewall areas, the indentations’ angularity or smoothness in cross-section, the frequency and regularity of the pattern of the indentations, the spacing between the indentations, and other factors.

[23] Examples of some of those many alternative designs are shown in FIG. 4 (illustrating a relatively shallow fluting 30 having a regular pattern around the periphery of a generally rectangular container) and FIG. 5 (showing a generally round container with relatively “deeper” and proportionally larger flute structures 32). FIGS. 4 and 5 illustrate a fairly regularly, sinusoidal or wavy pattern of corrugations, persons of ordinary skill in the art will understand that other embodiments can include spaced irregularities, and other pat-
terns and features within the corrugations or fluted pattern. Among the many other container shapes in which the invention has utility are oval, diamond, and others.

[24] Preferably, the fluting or corrugations 16 and the entire container assembly are strengthened by one or more generally horizontal rib structures 18 and 20. Persons of ordinary skill in the art will understand that these can be similar to conventional reinforcing ribs on container sidewalls, and that they preferably surround the periphery of the container's exterior to provide (among other things) hoop strength against internal loads and forces. Preferably, the ribs 18 and 20 span across the corrugations 16 and are affixed to the sidewall at opposite sides of each corrugation, to provide the desired hoop strength and to prevent undesired deformation of the container in the area of the corrugation. The location, angle, frequency, thickness, and other characteristics of any such reinforcing ribs 18 can be customized depending on a variety of factors.

[25] To provide a sealing engagement with a lid for embodiments in which the corrugations extend completely to the top of the container, the lid would have to have a corresponding pattern in its mating structure. Alternatively, the corrugations can be stopped below the top of the sidewall, permitting the use of conventional lid sealing arrangements, and also providing a step or ledge on which an internal flange on the lid can rest. That point of contact can help transfer loads that may be imposed by stacking or similar situations.

[26] For embodiments fabricated via injection molding of the like, the entire intersection of rib(s), corrugations, and sidewall portion can be integrally formed, providing even further strength. For other manufacturing processes and materials, welding, gluing, or
other means may be used effectively to bond these elements to each other. Persons of ordinary skill in the art will understand that not all of those elements have to be bonded to each other to provide some of the desired strengthening.

[27] One or more handles 22 can be formed on the sidewall portion 14, and may be connected to or integrally formed with a horizontal rib such as rib 18.

[28] Persons of ordinary skill in the art also will understand that conventional molding and other fabrication techniques can be utilized to manufacture the container of the invention.

[29] Thus, the preferred embodiment of the present invention provides methods and apparatus for strengthening containers by forming the sidewalls so that the cross-section of the wall includes something other than straight lines or smooth “concave out” arcs or curves. For example, a conventional round container without the invention has a cross section with a continuous “concave out” arc. In that regard, persons of ordinary skill in the art will understand that a wide variety of cross-sectional shapes may be used effectively in the invention (besides straight lines or smooth “concave out” arcs or curves). In other words, the invention includes forming one or more cross-sectional shapes or patterns into a container sidewall.

[30] The pattern or patterns can be relatively consistent (such as the sinusoidal or wavy pattern of FIGS. 4 and 5), can include spaced irregularities, can have relatively sharp (FIGS. 1-3) or smooth patterns or elements, etc. The “depth” of the pattern (how far in or out the element is positioned off of the general trend line of the wall's cross-section) and the
particular cross-sectional shape itself can be selected in order to provide varying degrees of “strength” for a given wall thickness. In alternative embodiments of the invention (not shown), the wall thickness itself can be varied at locations around the container and even within a single corrugation, to provide more or less strength and weight, etc.

[31] Preferably, the patterns or elements formed in the sidewalls extend generally the full height of the sidewall, and can “terminate” at the top and bottom in any suitable manner. In alternative embodiments (not shown), however, the patterns or elements can extend for only a part of the height of the wall, can be formed in sections spaced vertically from each other in a single container sidewall, or can be in any of a wide variety of other configurations and combinations.

[32] Methods of the invention include, by way of example and not by way of limitation, forming containers of the type described herein, nesting and stacking same, handling materials using such containers and associated lids, and other methods. Among other things, persons of ordinary skill in the art will understand that the corrugations make it less likely that heavy loads (such as caused by the contents of the containers and/or by the stacking of similar containers, or other things) will buckle the sidewall of the container.

[33] Possible benefits of the invention include, again by way of example and not by way of limitation, thinner walls being able to carry greater loads, less material being required to provide a container of a given “strength”, etc. Among other things, the invention may be used on containers for transporting materials and things. In such applications, the container itself is simply added weight that must be transported (the thing inside the container typi-
cally being the item sought by the end user). Accordingly, by providing sufficient container
wall strength with less material, the costs of shipping are reduced because each "thing" in
its package weighs less. Thus, persons of ordinary skill in the art will understand that the
invention is economically and environmentally beneficial.

[34] For square or other containers having corners, the patterns or other elements
can be located in the one or more of the corners (FIGS. 1-3 show it in all four corners), on
one or more of the sidewalls between the corners, or a combination of the foregoi

[35] Persons of ordinary skill in the art will understand that the container can be
fabricated in any of a wide range of useful sizes as well as a wide variety of shapes, and can
be manufactured from a wide variety of materials, including plastic, metal, etc. Methods of
manufacture include injection molding, blow-molding, and similar processes. Persons of
ordinary skill in the art also will understand that the containers preferably are nestable and
stackable with other similarly sized and shaped containers (among other things, this facili-
tates manufacture, handling, and storage of the containers in an unfilled condition).

[36] The apparatus and methods of my invention have been described with some
particularity, but the specific designs, constructions and steps disclosed are not to be taken
as delimiting of the invention. Obvious modifications will make themselves apparent to
those of ordinary skill in the art, all of which will not depart from the essence of the inven-
tion and all such changes and modifications are intended to be encompassed within the ap-
pended claims.
WHAT IS CLAIMED IS:

1. A method of storing, including the steps of providing a plurality of containers having a bottom and a sidewall portion extending upwardly therefrom, said sidewall portion including at least one generally vertical corrugation formed therein, filling said containers, closing said containers, and stacking said closed containers together.