Dec. 12, 1967 H. T. SEARS, JR., ET AL 3,357,593

TUBULAR WALL STRUCTURE

Filed Dec. 20, 1965 2 Sheets-Sheet 1

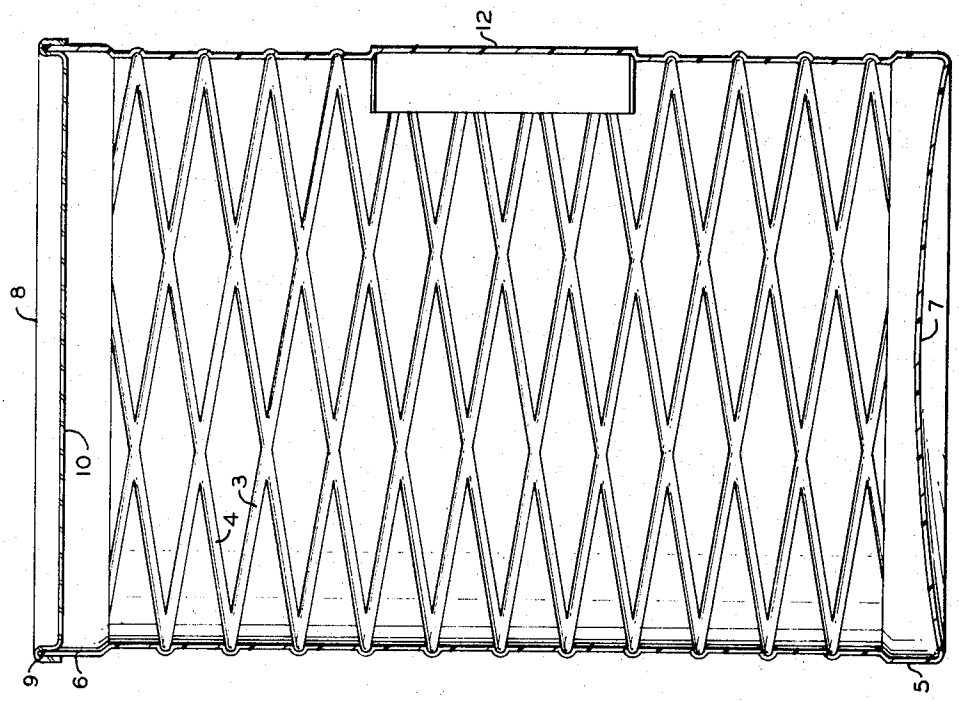

FIG. 2

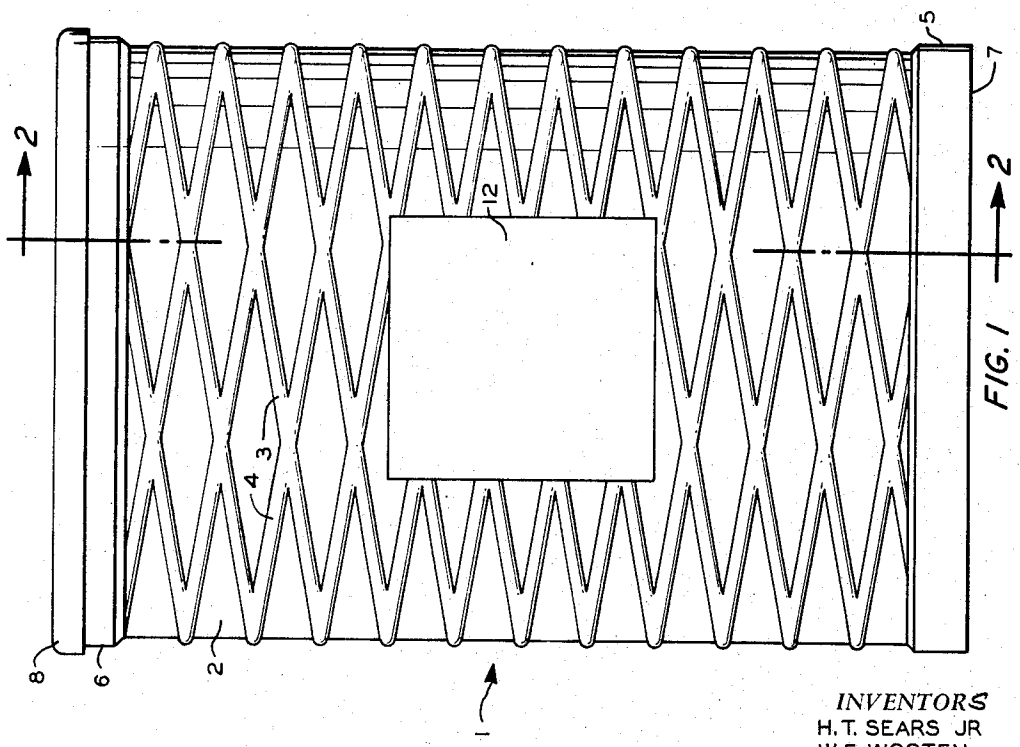

FIG. 1

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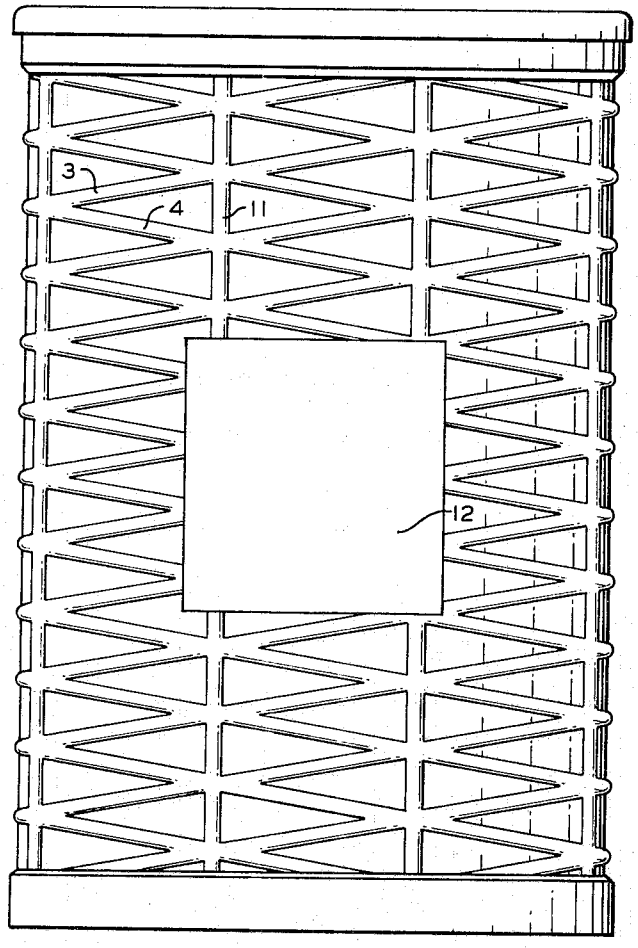

FIG. 3

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TUBULAR WALL STRUCTURE

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13 Claims. (Cl. 220—72)

ABSTRACT OF THE DISCLOSURE

Tubular side wall resistance to compressional and longitudinal force is improved by provision of integral cross-hatched helical corrugations.

This invention relates to an improved structure for the side walls of tubular elements, conduits and containers and a method for making the same.

In one aspect, the invention provides for an improved side wall structural configuration comprising helical indentations or ridges. In yet another aspect, the invention provides for a side wall structural configuration comprising continuous cross-hatched side wall deformations. In still another aspect, the invention provides for an improved tubular side wall structural configuration comprising cross-hatched helical indentations in addition to a separate series of said wall deformations aligned parallel with the axis of the tubular element, conduit, or container.

The compressional and impact strength of the side walls of tubular elements, conduits and containers is a primary consideration in the manufacture of such items, particularly where the side wall is relatively thin or composed of a material which is susceptible to deformation by compressional or impact forces. Such deformation or paneling is particularly a problem with relatively thin walled thermoplastic containers. Where such containers are designed to withstand only nominal compressional forces either from without or within they are susceptible to deformation or paneling due to impact or longitudinal stresses encountered in the handling or opening of the containers. In order to avoid such deformation in smooth walled containers it is necessary to overdesign the thickness of the side wall at a consequent increase in expense of materials, manufacturing and handling, and a concurrent increase in container weight.

The applicants have found that the strength of the side wall of tubular elements, conduits, and containers can be significantly increased by providing the tubular side wall with integral cross-hatched helical deformations. These deformations or corrugations can be incorporated into the side wall material either before, during, or after the manufacture of the finished article. By the now preferred method of manufacture, the tubular article is blow molded in one step as later described, in which event the continuous deformations can be easily incorporated into the side wall in the same operation with essentially no increase in the cost of materials or handling. The invention further provides for increased strength in the longitudinal direction through the provision of yet another series of deformations parallel to the axis of the tubular article in addition to the cross-hatched helical corrugations.

One object of this invention is to provide a tubular article of increased side wall strength. Another object of this invention is to provide a tubular article resistant to paneling or side wall deformation. Another object of this invention is to provide a tubular article with improved resistance to accordian like deformation. Yet another object is to provide a tubular article of improved resistance to both compressional and longitudinal forces at no increased cost.

Other aspects, objects and advantages of this invention are apparent from a study of this disclosure, the drawings and the appended claims.

In accordance with this invention there is provided a tubular article of improved resistance to compressional and longitudinal forces comprising a side wall with integral cross-hatched helical corrugations. In accordance with one embodiment of this invention there is provided a tubular molded thermoplastic article with integral cross-hatched helical corrugations extending substantially over the length of the article.

In accordance with a further embodiment of this invention there is provided a tubular article with integral helical cross-hatched corrugations together with a series of corrugations oriented parallel to the axis of the tubular article.

Further in accordance with the invention there is provided a container comprising a tubular side wall having one or both structural features above described and also having an integrally formed bottom enclosure as well as a separate closure on the other end of the tubular element, said separate closure being fixedly attached to the tubular section after the container is filled for the purpose of sealing the container and its contents. In one preferred embodiment of this invention the tubular side wall and an integral end closure can be formed in one step from a semirigid material such as a thermoplastic, particularly polypropylene or polyethylene. The tubular side wall can also be provided with a smooth portion for the application of insignia or advertisement. The separate end closure can be composed of any material which can be fixedly attached to the tubular section and subsequently removed or punctured for the removal of the contents.

In order to allow the cooperation of the separate closure with the tubular section, the side wall can be provided with a smooth portion at the end to which the separate closure is to be attached, said smooth portion extending completely around the tubular section and for only a short distance from the end along the longitudinal axis of the container. In order to preserve the symmetry of the container and to add to its appearance, the opposite end comprising the integral closure also can be provided with a smooth portion having dimensions similar to that of the smooth portion at the other end.

The containers of the present invention can be made by blow molding the tubular section and integral closure in one operation with subsequent application of the separate closure. In this process a pair of extruded sheets or a parison of the plastic material is introduced between two mold sections, and when the mold sections are locked together, air or other gaseous fluid is introduced into the parison or between the sheets to bring them into pressure engagement with the contour of the closed mold. Following the molding operation, the mold form is cooled and the mold is opened to permit removal of the hollow closed shell of which one end is subsequently opened to allow filling. This simple process is readily adaptable to mass production which of course is essential to the low cost of the product.

Alternatively, the containers of the present invention can be made by vacuum forming. Suitable methods for vacuum forming the article of the present invention are described in U.S. Patent No. 3,099,043, issued July 30, 1963, to Edward C. Held, Jr.

The containers of this invention can be made of a semi-rigid thermoplastic material, preferably derived from α-olefins, such as high density ethylene or propylene polymers. Other examples of suitable plastic materials are homopolymers and copolymers of α-olefins of 2 to 8 carbon atoms such as polyethylene, polypropylene, ethylene-butene-1 copolymers and the like.

The invention can be more fully understood by reference to the accompanying drawings in which:

FIGURE 1 is a side view of a tubular container which is a presently preferred embodiment of this invention.

FIGURE 2 is a side sectional view of the container of FIGURE 1.

FIGURE 3 is a modification of the container of FIGURE 1 comprising, in addition to the helical cross-hatched corrugations, another series of vertical corrugations aligned parallel to the longitudinal axis of the container.

Referring now to the drawings, FIGURE 1 shows a tubular container **1** which is a preferred embodiment of this invention. In the tubular side wall **2** there are formed, as an integral part thereof, two series of cross-hatched helical corrugations the one series shown at **3** running down to the left across the face of the container and the other series shown at **4** running down to the right across the face of the container. At both ends of the tubular side wall there are smooth portions **5** and **6** which are free of corruguations. The lower end of container **1** is closed by an integrally formed bottom **7**. The other end of the tubular side wall is closed with separate closure **8** which is applied to the container subsequent to its fabrication and which can be formed from any suitable metallic or thermoplastic material which can be either crimped or sealed to the top of the container. The tubular side wall can further have a smooth portion on the corrugated section shown at **12** for the application of insignia or advertisement. The tubular side wall with all of the described features and the integral bottom may be fabricated in one simple step by blow molding as previously described. The thus fabricated container is subsequently filled and sealed by the separate closure **8** which can be either crimped or heat sealed to the open end of the tubular section.

FIGURE 2 shows a sectional view of the container of FIGURE 1 illustrating a cross section of the side wall and the inner surface of the container. The integrally formed corrugations are shown at **3** and **4** and the smooth portions at the extremities of the tubular section are shown at **5** and **6** as corresponding to FIGURE 1. The integrally formed bottom shown at **7** can be concave to increase its rigidity. The separate closure **8** can comprise a flat portion **10** fabricated to correspond to the lateral cross section of the tubular section and can be crimped at its periphery to cooperate with the open end of the tubular section as shown at **9** and thereby seal the container.

FIGURE 3, showing another embodiment of the container of FIGURE 1, comprises in addition to the features of the containers of FIGURES 1 and 2 another series of corrugations shown at **11** which are also integrally formed during blow molding step and which are oriented parallel to the axis of the tubular section. These longitudinal corrugations have been shown to greatly increase the container's resistance to longitudinal deformation which sometimes results from opening or handling thin walled containers.

Specific embodiments of this invention as defined by the drawings and the descriptions thereof are not intended to limit the scope of this invention, but are employed only as means of illustrating the application of the concept of this invention in a particular instance. The structural features described can be utilized with substantial benefit in any tubular structure whether the finished article be a container, conduit or an element of some compounded article.

The above described deformations can comprise either ridges extending radially outward from the tubular side wall or grooves extending radially inward from the tubular side wall. The space between the several members of each set of helical corrugations can be the same along the length of the tubular element, or the spacing can be varied from one end of the tubular side wall to the other, or it can vary in some predetermined repeating pattern.

For example, the distance between members of the same set of helical deformations can be relatively small at one end of the tubular element and can increase toward the other end of the tubular element. Similarly, the distance between deformations can increase from a predetermined minimum value to a predetermined maximum value and then decrease to the aforesaid minimum value to provide a decorative effect. The deformations of each series of helical deformations can be disposed to the longitudinal axis of the container at an angle of from about 5–85° with the further provision that the angle at which each member is disposed to the longitudinal axis need not be the same as for other members of the same series, and that the orientation of each successive member of each series can be varied to provide an improved structural or decorative effect. It is further within the scope of this invention that the orientation of the members of one series of helical corrugations to the longitudinal axis need not be the same as that of the members of the other series of helical corrugations, i.e., the members of one series may be disposed to the longitudinal axis of the tubular element in a manner different from that of the other series of corrugations. However, it is presently one preferred embodiment of this invention that the aforesaid helical corrugations be disposed about the longitudinal axis of the tubular element in a symmetrical manner. For example, the disposition of the aforesaid deformations would be symmetrical where the angle of orientation of one member of the first set of deformations to the longitudinal axis is the same as the angle of orientation of the corresponding member of the second set of deformations.

Although the preferred embodiment of this invention provides that the structural side wall deformations be helical in configuration as illustrated in the drawings, it is within the scope of this invention, as pointed out above, to provide a structural side wall configuration of other than helical design. For example the cross-hatched side wall structure can be comprised of a series of continuous deformations of which each deformation or element of the series is elliptical. In other words, the side wall structure can comprise a cross-hatched network of closed elliptical elements extending about the circumference of the side wall. The spacing between these elements and their orientation to the axis of the article can be similar to the spacing and the orientation of the above described helical side wall deformations.

Reasonable variation and modification are possible within the scope of this invention, the essence of which is that there is provided a tubular article the side wall of which has, as an integral part thereof, integrally formed cross-hatched continuous corrugations or deformations and which can further have another series of integrally formed corrugations or deformations oriented parallel to the axis of the said tubular article.

We claim:

1. An integral reinforcing structure for tubular members, said structure comprising an integral network of cross-hatched continuous surface deformations of the total side wall thickness of said tubular member extending about the circumference of said tubular member.

2. The structure of claim **1** in which said deformations are helical.

3. The structure of claim **1** in which the deformations are eliptical.

4. The structure of claim **1** in which said deformations comprise a series of ridges equidistant from other ridges of the same series at all points and intersecting the ridges of another series of which the members are also equidistant at all points.

5. The structure of claim **4** in which said deformations are grooves rather than ridges.

6. The structure of claim **1** in which said deformations are oriented such that they are neither parallel to nor perpendicular to the longitudinal axis of said tubular member.

7. The structure of claim 1 wherein said deformations are oriented with respect to said longitudinal axis such that the angles between said axis and the members of each series are of the same magnitude.

8. The structure of claim 1 wherein said network further comprises a series of deformations disposed parallel to said longitudinal axis.

9. The structure of claim 1 in which said tubular member has at least one end closed.

10. The structure of claim 1 wherein said tubular member has closures at both ends, with the closure at one end comprising a concave disk formed as an integral part of said side wall.

11. The structure of claim 1 wherein said closed tubular member has a smooth portion on the side wall for receiving advertisement.

12. The structure of claim 1 wherein said closed tubular container has a circumferential smooth portion at each longitudinal extremity extending axially away from said extremity for only a short distance.

13. A cylindrical container having integral cross-hatched corrugations in the side wall thereof, said corrugations comprising two sets of helical ridges with the ridges of each set being disposed to the longitudinal axis of the container at an angle of from 5 to 85°, said angle being the same magnitude for each set, said cylindrical wall having still another set of corrugations disposed parallel to the axis of said container, said cylindrical wall having a smooth portion on one side for fixing thereon insignia or advertisement, said container being closed at both ends with one end having an integral closure, said integral closure being slightly concave with the opposite end having a separate closure, said separate closure being fixedly attached to said cylindrical portion by means of a crimp formed at the outer extremities of said cylindrical wall, said container being composed of a thermoplastic material, said separate closure being composed of a thermoplastic material, and said cylindrical portion and integral closure being molded.

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