Sept. 13, 1966 H. L. CARPENTER, JR 3,272,094

TAPERED FIBER DRUM AND METHOD OF MAKING THE SAME

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FIG. 1

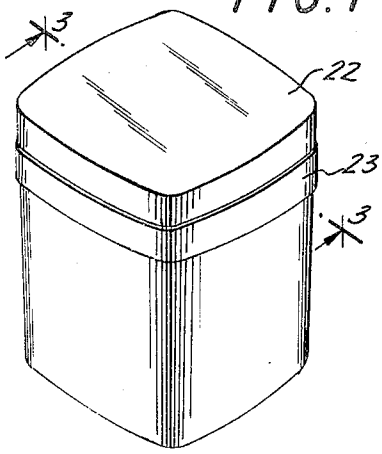


FIG. 2

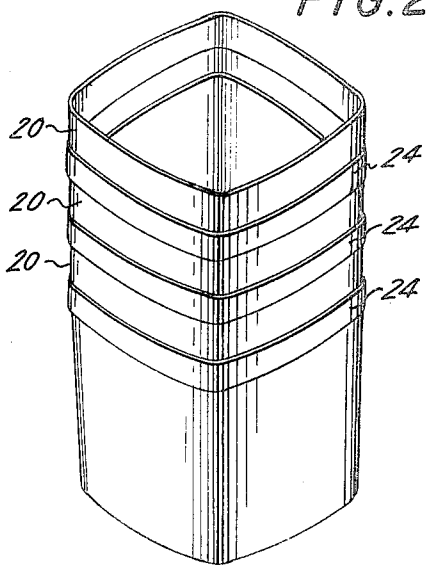
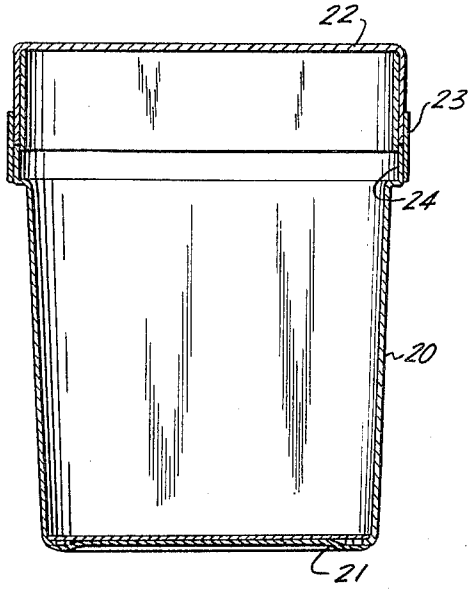


FIG. 3



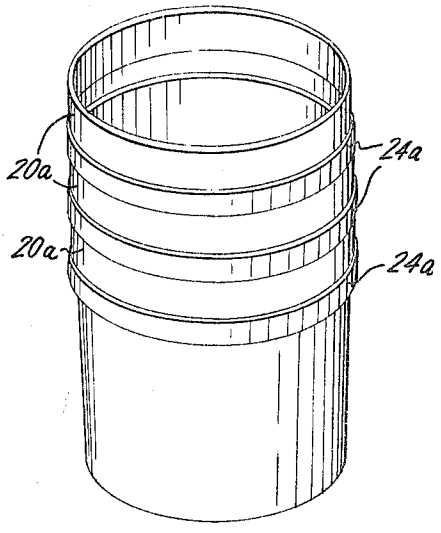


FIG. 4

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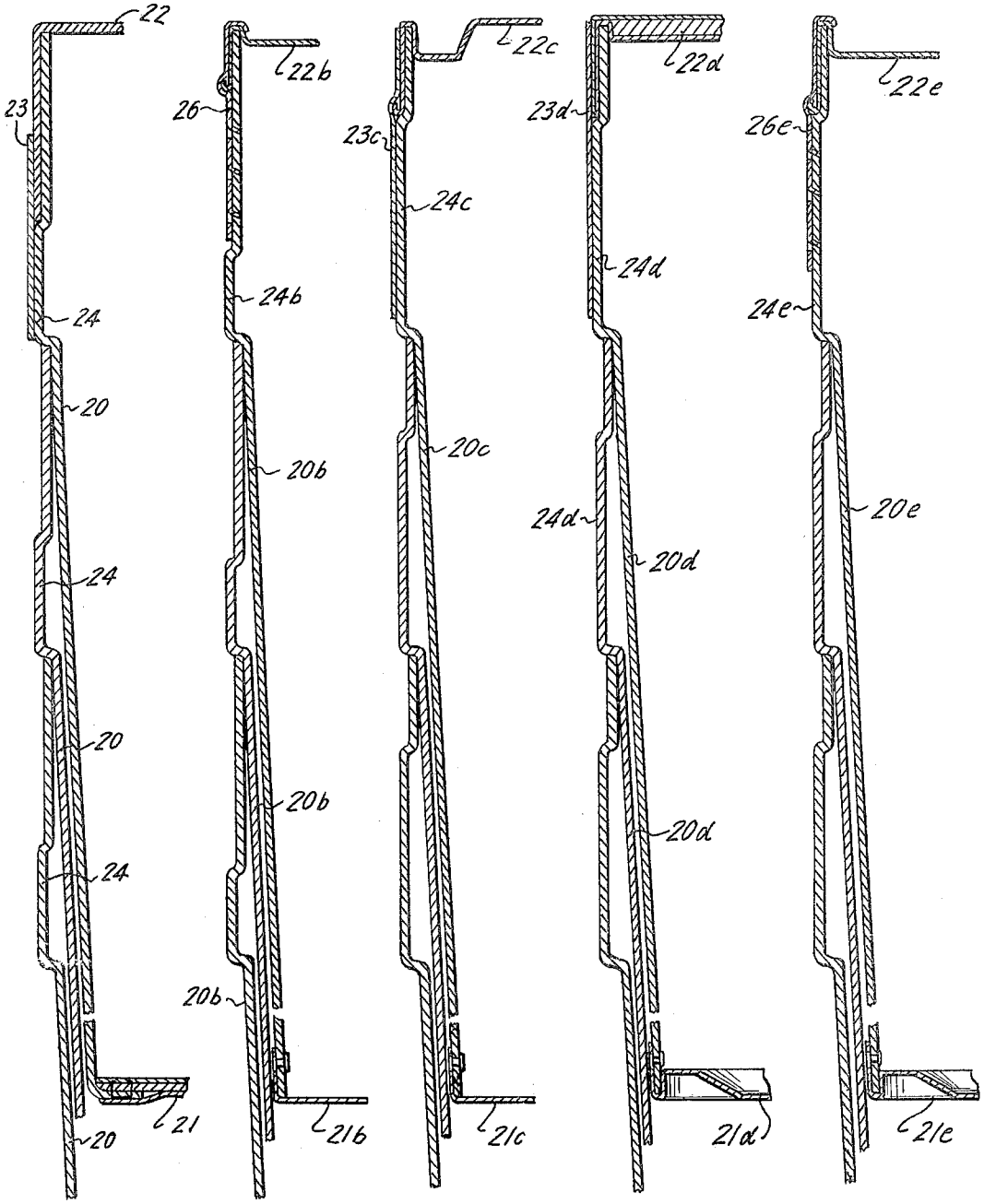
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TAPERED FIBER DRUM AND METHOD OF MAKING THE SAME

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FIG.5 FIG.6 FIG.7 FIG.8 FIG.9



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FIG. 10

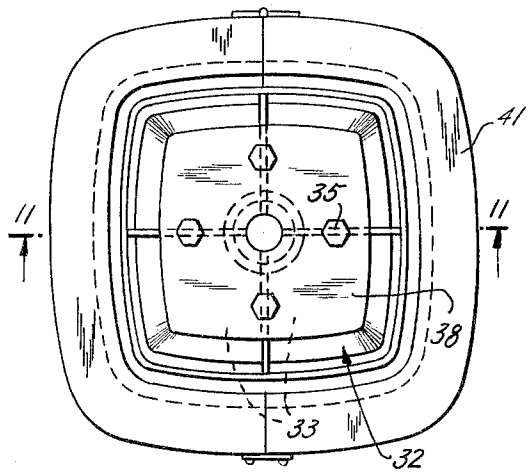


FIG. 12

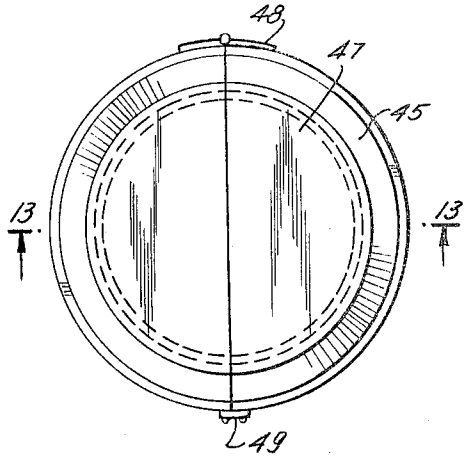


FIG. 11

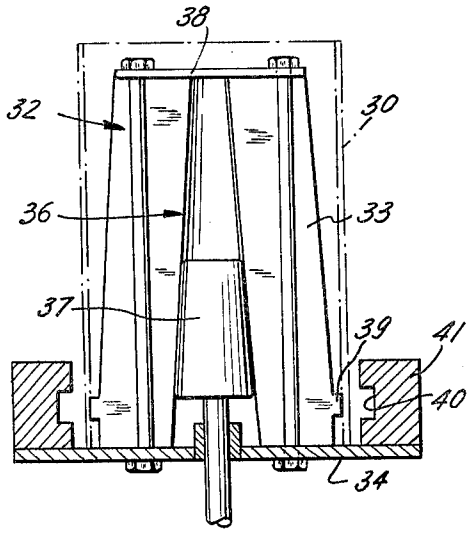
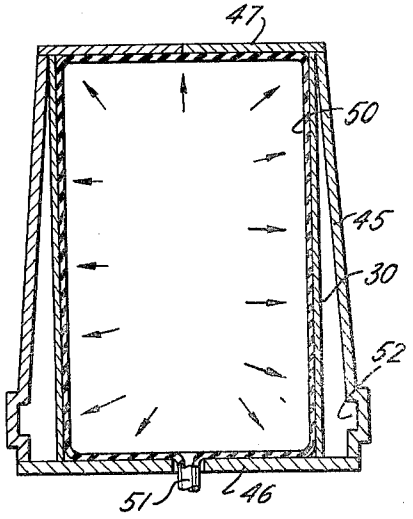


FIG. 13



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FIG. 14

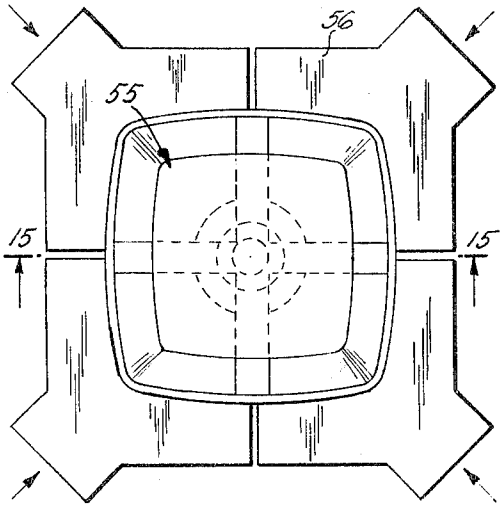


FIG. 16

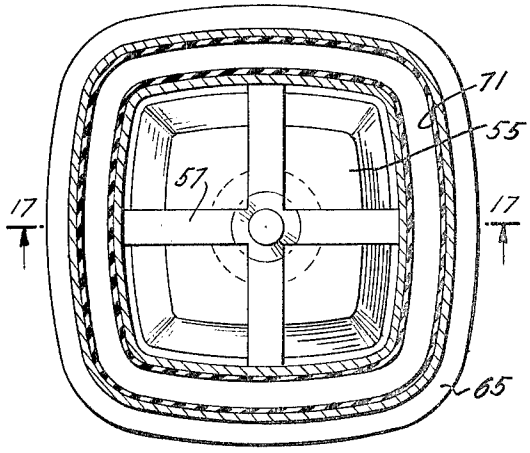


FIG. 15

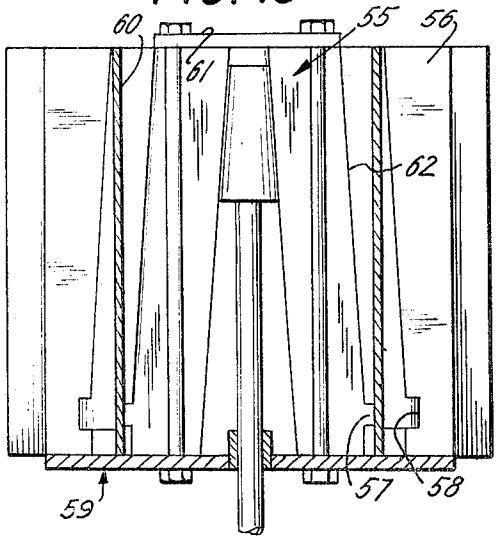


FIG. 17

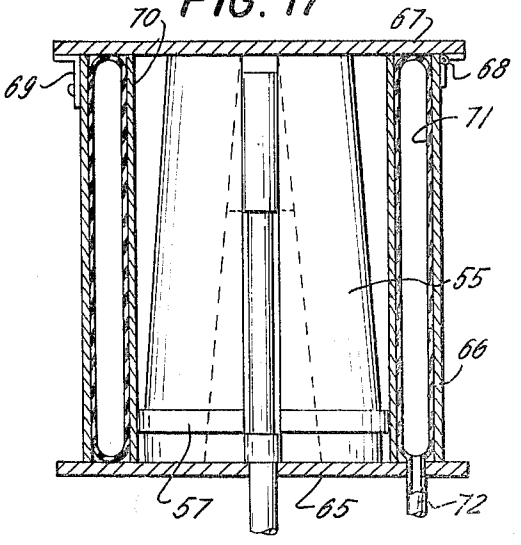
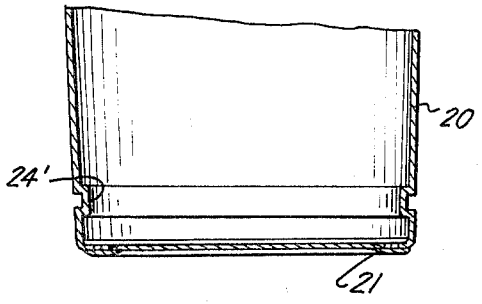


FIG. 18



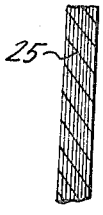


FIG. 19

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United States Patent Office 3,272,094 Patented Sept. 13, 1966

3,272,094

TAPERED FIBER DRUM AND METHOD OF MAKING THE SAME

Herbert L. Carpenter, Jr., Babylon, N.Y., assignor to The Greif Bros. Cooperage Corporation, Delaware, Ohio, a corporation of Delaware

Filed Jan. 23, 1964, Ser. No. 339,751
15 Claims. (Cl. 93—39.1)

This invention relates to the art of fiber containers.

It is a particular objective of this invention to provide improved fiber containers and also an improved method of making the same wherein the containers are of tapered construction so that they can be stacked in nested relationship to save space in shipping and storing empty containers.

Fiber drums and containers made from convolutely wound laminated layers of kraft paper or fiber are extensively used for shipping and storing raw materials, chemicals and many different manufactured articles. Generally speaking, fiber containers have served very satisfactorily for these purposes and they are in increasing demand. However, they present the disadvantage that, because they are large and bulky and cannot be collapsed, they require a great deal of space for shipping and storing while in empty condition.

I have found that this disadvantage can be overcome by providing an improved fiber container having a tubular container body of tapered construction, increasing gradually and substantially uniformly in all cross-sectional dimensions from its base portion or lower end to its open upper end, whereby it may be stacked with other similar containers nested through the open end thereof. I have also found that tapered fiber containers may be made by first providing a tubular fiber shell made of convolutely wound laminated layers of kraft paper or other fibrous material with the fber shell in stretchable and deformable condition. It is then arranged with one surface disposed adjacent a tapered form, and force is applied between the form and the shell to cause the shell to assume the tapered configuration of the form gradually and substantially uniformly increasing in all cross-sectional dimensions from one end to the other.

I have found that by using extensible fibrous material such as extensible kraft paper in forming the fiber shell, the paper is in stretchable and deformable condition and can be made to readily conform in configuration with the tapered form.

In the preferred embodiment of the invention, the tubular fiber shell is made of extensible paper and the tapered form is adjacent one surface of the shell. Force is then applied to cause the shell to expand into configuration with the tapered conformation of the form.

A closure is permanently applied to the end of the shell of smallest cross-sectional dimensions and the opposite end is left in open condition to receive a removable closure. Thus, the shells may be stacked in nested configuration through the open ends thereof.

In the accompanying drawings:

FIG. 1 is a perspective view of one form of tapered fiber drum embodying my invention;

FIG. 2 is a perspective view of a plurality of fiber drums with their head closures removed and arranged in stacked, nested relationship;

FIG. 3 is a cross-sectional view in the direction of the arrows on the line 3—3 of FIG. 1;

FIG. 4 is a perspective view similar to FIG. 2 showing a plurality of tapered fiber drums of modified construction arranged in stacked, nested relationship;

FIG. 5 is an enlarged, fragmentary, detailed, sectional view of tapered containers of the type shown in FIG. 1 arranged in stacked, nested relationship and showing only portions of one side wall of each container and of the adjacent portions of the bottom and top closure of the uppermost container so as to illustrate the interfitting and nested relationship of the containers;

FIG. 6, FIG. 7, FIG. 8 and FIG. 9 are views similar to FIG. 5 showing enlarged, fragmentary, detailed, sectional views of stacked, tapered fiber containers having modified closure and wall constructions;

FIG. 10 is a top plan view showing one type of forming die for mechanically expanding a shell of uniform diameter into tapered configuration;

FIG. 11 is a longitudinal, sectional view in the direction of the arrows on the line 11—11 of FIG. 10;

FIG. 12 is a top plan view of another type of die for hydraulically expanding a fiber shell of uniform diameter into tapered configuration;

FIG. 13 is a longitudinal, sectional view in the direction of the arrows on the line 13—13 of FIG. 12;

FIG. 14 is a top plan view of a further type of forming die which may be used for contracting a fiber shell of uniform diameter into a tapered shell;

FIG. 15 is a longitudinal, sectional view in the direction of the arrows on the line 15—15 of FIG. 14;

FIG. 16 is a cross-sectional view of a further modified type of forming die for hydraulically contracting a fiber shell of uniform diameter into tapered configuration;

FIG. 17 is a longitudinal, sectional view in the direction of the arrows on the line 17—17 of FIG. 16;

FIG. 18 is a detailed, sectional view on a smaller scale of the lower portion of a fiber container in which the projecting means or rib is formed on the inner surface near the closed lower end of the container rather than on the outer surface of the open upper end; and

FIG. 19 is a detailed, sectional view of a portion of a fiber shell of the type used in making my improved tapered fiber container indicating the convolutely wound laminated character thereof.

My invention is applicable to any type of fiber container having a tubular container body including a shell made of convolutely wound adhesively laminated layers of kraft paper or fibrous material.

The container body may be made in one piece simply of the fiber shell. If preferred, it may be coated or lined with a suitable coating material or with paper plastic foil, or the like. Alternately, the container body may be made of a fibrous material impregnated with a resin or plastic. Also, the container body may be of composite construction with the outer portion made of the fiber shell and the inner portion made of a metal or plastic shell.

Also, the container body may be of varying cross-sectional shapes, thus it may be circular in cross-section or it may be of modified rectangular cross-section.

In FIGS. 1, 2 and 3 we have shown a tapered fiber container embodying my invention of modified rectangular construction. Thus, the container shown in these figures has a four-sided tubular container body **20**. Each side has a transversely convex outer surface and a transversely concave inner surface and the sides are integrally joined together by rounded corners.

In the illustrated embodiment, the container body **20** is formed of a tubular fiber shell formed of convolutely wound laminated layers of kraft paper or fibrous material. FIG. 19 is a detailed view of a side wall of the container and it will be seen that it is formed of separate layers **25** of kraft paper laminated together.

The fiber shell is of tapered construction increasing gradually and substantially uniformly in all cross-sectional dimensions from its lower end to its upper end. The lower end of smaller cross-sectional size is closed as

shown at **21** by a closure which is permanently secured to the inturned lower ends of the fiber shell. The form of closure may be varied. In the illustrated embodiment, the bottom closure consists of a fiber disc stapled to the inturned lower end of the container body. A disc of paper may be adhesively secured over the outer surface of the bottom of the container to impart a finished appearance thereto.

The upper end of the container of larger cross-sectional size is open and a suitable removable closure may be applied thereto. In the illustrated embodiment, the removable closure **22** is in the form of a cap having a side wall or apron which slides telescopically over the upper side walls of the container body. Thus, the closure **22** may be applied or removed by a simple sliding action. When the removable closure **22** is applied, it may be retained in place by a strip of adhesive tape **23** applied around the overlapping edges of the closure and container body, as shown.

Due to the tapered construction with the closed lower end being of smaller diameter and the open upper end being of larger diameter, the containers may be stacked in nested relationship as shown in FIG. 2.

If the walls of adjacent containers were in immediate contacting engagement with each other when the containers were thus nested together, a frictional or wedging binding would occur between the container bodies, which would make it difficult to separate them from each other. In order to prevent this binding action from occurring, I provide each container body with laterally projecting means on one surface thereof adjacent one end of the body for supporting engagement with the end portion of a container engaged therewith. Thus, as shown in FIG. 3, I may provide the container body **20** with an outwardly projecting stacking rib **24**, extending around the outer peripheral surface of the container body adjacent the open upper end thereof. Thus, when the container bodies **20** are stacked in nested relationship as shown in FIG. 2, the stacking rib **24** of the superimposed container rests on the upper edge portion of the container immediately therebeneath. This supporting engagement of the ribs of the successive container bodies on the upper surface of the container body therebeneath serves to hold the container body walls in slightly spaced relationship and prevent binding or wedging engagement therebetween.

This is clearly illustrated in FIG. 5, where portions of the side walls of three stacked or nested containers are shown. It will be seen that the rib of the uppermost container rests on the upper surface of the second container and that the rib of the second container in turn rests on the upper edge portion of the third container. It will also be seen that the walls of the respective nested containers are thus maintained in slightly spaced relationship to prevent binding engagement therebetween.

Instead of being formed around the outer surface near the open upper end of the container body, the stacking rib may be formed around the inner surface of the container body near the closed lower end, as shown at **24'** in FIG. 18. Thus, the lower edge portion of a container body nested inside the container body **20** shown in FIG. 18 will rest on and have supporting engagement with the internal rib **24'** holding the walls of the container bodies in slightly spaced relationship and preventing binding engagement therebetween.

The modified rectangular cross-sectional shape of the container body, shown in FIGS. 1, 2 and 3, is highly efficient for stacking purposes. Thus, it will be seen that in surface area there is a minimum of waste space because the containers may be placed side by side with very little spacing therebetween. In addition, the containers may be stacked in nested relationship, as shown in FIGS. 2 and 5. In this connection, the greater the number of containers that are stacked in nested relationship the greater the efficiency or saving in space. This is due to the fact that a single container resting on a supporting platform occupies a vertical space represented by the full height of the container. Each additional container only adds the space required by the distance from the lower edge of the stacking rib to the upper edge of the container.

It should be understood, however, as pointed out above, that our invention is applicable to containers of any cross-sectional shape. Thus, in FIG. 4 we have shown a plurality of fiber containers of circular cross-sectional shape arranged in stacked, nested relationship. The three nested containers shown in FIG. 4 are of similar construction. Each is formed with a tubular body portion **20A** of tapered construction, closed at its lower end and open at its upper end. The body portions are of circular cross-sectional shape and increase gradually and substantially uniformly in all cross-sectional dimensions from their closed lower ends to their open upper ends. Each of the body portions includes a fiber shell made of convolutely wound adhesively laminated kraft paper or fiber. Each of the body portions **20A** is also formed with an external stacking rib **24A** extending around the periphery of the outer surface thereof adjacent but spaced from the upper end. This stacking rib may, of course, be arranged as shown in FIG. 18 around the inner surface near the closed lower end of the container body.

In addition to varying the cross-sectional shape of the container body, we also may assemble different forms of closures therewith. When varying the form of closure, it might be necessary or desirable to vary the size of the stacking rib or to vary the spacing of the rib from the end of the container body.

Thus, in FIGS. 6, 7, 8 and 9 we have shown various types of closure assemblies associated with tapered fiber containers embodying my invention. FIGS. 6 to 9 are similar to FIG. 5 and show in cross-sectional detail portions of the side walls of three nested tapered fiber containers embodying my invention. In each of these figures, the associated portions of the lower permanently attached closure and of the upper removable closure for the uppermost container is shown.

In FIG. 6, we have shown portions of the tapered side wall of three superimposed container bodies **20B**. The container body is of the same convolutely wound laminated fiber construction and may be of any desired cross-sectional shape, as for instance, the modified rectangular or circular cross-sectional shape shown in the first 4 figures of the drawings. In this case, however, the container body is provided with a metal closure **21B** permanently secured to the lower end thereof as by being folded over the lower portion of the side wall and riveted thereto, as shown at the lower portion of FIG. 6. Each container **20B** may also be adapted to receive a removable metal closure **22B** at its open upper end. The metal closure **22B** may have a peripheral grooved portion as shown to receive the upper edge of the container body and may be provided with an apron which overlaps the outer surface of the upper portion of the container body. The removable closure may be suitably secured in place, as by means of spring clips **26** secured to the outer surface of the upper portion of the container body as by means of integral prongs or rivets extending into the fiber as shown.

The upper end of the prong may be snapped into overlapping relationship with the peripheral portion of the removable closure **22B** to hold it in place and may be snapped outwardly to release the cover and permit its removal.

In order to provide sufficient space to accommodate the spring clip **26**, we space the upper end of the stacking ribs **24B** a greater distance from the upper edge of the container body. Thus, in FIG. 6 the stacking ribs **24B** are similar in all respects to the ribs **24** in the first form of my invention, but are somewhat narrower and the upper edges are spaced a greater distance from the upper edge

of the container body. When the containers are stacked as shown, the ribs are in supporting engagement with the upper edge of the container immediately therebeneath thereby holding the walls of the container bodies in spaced relationship and preventing binding action.

In FIG. 7 I have shown three superimposed tapered fiber container bodies 20C which may have metal closures 21C similar to the metal closures 21B secured to the lower ends thereof.

A modified type of metal closure 22C is removably secured to the upper end thereof, as shown in FIG. 7. This form of closure also overlaps the upper end of the container body and has a skirt or apron in sliding engagement with the outer surface thereof. Instead of employing clips for releasably holding the cover in place, I preferably employ a strip of adhesive tape 23C which is simply wrapped around the adjacent portions of the cover apron and of the outer surface of the container body, as shown. In this connection, we prefer that the lower edge of the cover apron and the upper edge of the stacking rib 24C be in closely positioned relationship so that the tape can extend directly from the outer surface of the stacking rib to the apron of the cover. Thus, the stacking rib 24C is made somewhat wider than in the first two forms of my invention with the result that the upper edge of the stacking rib is positioned closer to the upper edge of the container.

In FIG. 8 the container bodies 20D are of the same tapered fiber construction. In this case, however, a further modified form of metal closure 21D is permanently secured to the bottom as by being riveted thereto. A modified form of cover made of combined metal and fiber or all fiber is shown at 22D and is removably applied to the upper end of this form of container. The cover 22D has an apron overlapping the outer surface of the container body, and it may be held in place as shown by a strip of adhesive tape 23D wrapped around the outer surface of the container and the apron. So as to provide relatively smooth abutting surfaces to which the tape may be applied, I prefer that the lower end of the cover apron be positioned immediately adjacent the stacking rib 24D, as shown. For this purpose, the rib 24D is similar to the rib 24C, i.e. it is wider than the ribs shown in the first two forms of my invention and is positioned closer to the upper edge of the container.

The container bodies 20E shown in FIG. 9 are similar to the container bodies 20C and 20D shown in FIGS. 7 and 8, and they have similar stacking ribs 24E. The metal closure 21E permanently attached to the lower end of the container body 20E is similar to the closure 21D. A metal closure 22E is removably applied to the open upper end of the container body 20E. It has a skirt or apron in overlapping relationship with the outer surface of the upper portion of the container body. The cover 22E is releasably secured in place by means of spring clips 26E, similar to the clips 26. In this case, however, the clips are applied to the outer surface of stacking rib 24E.

Thus, it will be seen that the fiber container bodies may be made in a variety of cross-sectional shapes, they may be provided with a variety of different types of permanently applied closures at their lower ends, and a variety of different types of removable closures to their upper ends. Similarly, the size and specific location of the stacking ribs may be varied to facilitate the application of different types of removable cover assemblies. In each form of my invention, however, the container body includes a tubular fiber shell formed of convolutely wound laminated layers of kraft paper or fiber and the shell is of tapered construction increasing gradually and substantially uniformly in all cross-sectional dimensions from the lower end thereof to the upper end thereof. Also, in each form of my invention, when the containers are stacked in nested relationship the stacking ribs provide supporting engagement with one end of a container body nested therewith. The production of a tapered fiber container body of this

type presents problems. Thus a fiber container of this type cannot be convolutely wound in tapered form. Also, paper and fiber of this type cannot generally be stretched or deformed without rupturing or distorting the fibers.

I have solved the problem by first forming a tubular fiber shell from convolutely wound, adhesively laminated layers of paper or other fibrous material in which the shell is of uniform cross-sectional dimensions from end to end. The fiber of the shell should be in stretchable, deformable condition and one surface thereof should be placed adjacent a tapered form and a force should be applied between the tapered form and the shell so as to cause the shell to conform to the form and assume the tapered configuration thereof. Force may be applied mechanically or may be applied by fluid pressure, such as hydraulic pressure.

In FIG. 19, we have shown a detailed cross-sectional view of a fiber shell wall indicating the separate laminations 25. These are convolutely wound and adhesively laminated together as by means of a liquid containing adhesive, such as casein adhesive or a synthetic resin adhesive.

In the preferred form of my invention, the tubular fiber shell is made from kraft paper of the extensible type. Extensible paper is well known, and it may be stretched in any direction when force is applied thereto. The outer surface of the paper is smooth, and is not creped, but during the manufacture of the paper web the fibers have been compacted and pressed together so that the finished paper may be stretched. Paper of this type may be made as taught in Patent No. 2,624,245 issued January 6, 1953, and is commercially available from West Virginia Paper Company and others under the trademark Clupak.

Kraft paper of the extensible type is convolutely wound into a shell of the desired cross-sectional shape, and the successive layers are adhesively laminated together. In a fiber shell of this type made of extensible kraft paper, the paper or fiber is in stretchable, deformable condition.

To a lesser extent, the paper or fiber in a fiber shell made from ordinary kraft paper or other fibrous material may be in stretchable, deformable condition if the fiber shell is freshly made prior to the setting of the adhesive, and if the fiber is still wet from the liquid containing adhesive.

In FIGS. 10 through 17, we have shown fiber shells of uniform cross-sectional dimension from end to end with one surface disposed adjacent to a tapered form preparatory to the application of force, either by mechanical or hydraulic means, to cause the fiber shell to conform in taper with the form and assume the configuration thereof. In each of these embodiments, the fiber or paper of the shell is in stretchable, deformable condition. In this connection, the fiber shell is preferably made of convolutely wound, adhesively laminated layers of extensible kraft paper, as defined above. The extensible kraft paper remains stretchable and deformable when wound into a shell in this fashion so that the shell can be formed in the manner hereinafter described. Alternatively, the shell can under certain circumstances be made of ordinary kraft paper and is convolutely wound and laminated with a liquid containing adhesive. Prior to the time that the adhesive is set, and while the fibers are still wet with the liquid of the adhesive, the fiber material is stretchable and deformable to a limited extent, and the shell can be formed as hereinafter described.

In FIGS. 10 and 11, I have illustrated one procedure for forming a shell of uniform diameter throughout its length into a tapered shell by mechanically expanding the shell.

Thus, I have shown a fiber shell 30 formed of convolutely wound layers of adhesively laminated kraft paper. The shell is of modified, rectangular, cross-sectional shape and is of uniform diameter from end to end. The paper or fiber of the shell is in stretchable, deformable condition, preferably by making the shell out of extensible kraft paper. The shell is assembled around

a tapered form **32** so that the inner surface of the shell is disposed immediately adjacent the tapered surface of the form.

The form **32** is of modified, rectangular, cross-sectional configuration as shown, having transversely curved sides with rounded corners. It also tapers from the lower end to the upper end so that it gradually and substantially uniformly decreases in all cross-sectional dimensions.

The form is expandable and contractable so that it can expand the fiber shell into the desired tapered configuration. Thus, in the illustrated embodiment, the form is made of four segments **33** which shift radially outwardly to expand, and radially inwardly to contract. They are supported in a base and frame structure **34** and **35**. When shifted inwardly, to the innermost portion of the segments, the form is of smaller cross-sectional dimension than the shell so that the shell may be assembled thereabout, as shown in FIGS. 10 and 11. When expanded, the tapered segments shift outwardly so as to expand the lower portion of the fiber shell as viewed in FIG. 11, imparting thereto the tapered configuration of the form.

The segments may be shifted outwardly to expand the form in any desired manner. Thus, in the illustrated embodiment, the segments are arranged so as to have a truncated, conical, central recess **36** and a truncated, conical, expanding cam **37** which shifts upwardly therein to shift the segments apart and to expand the form. When the cam **37** is shifted downwardly, the segments may be shifted inwardly to contract the form, permitting the removal of the shell from the form and the placing of another shell in position. The segments **33** shift inwardly and outwardly beneath the base **34** and top plate **38**. Thus, the segments will be maintained in their proper upright position while shifting, tapering inwardly from their lower ends to their upper ends.

The stacking rib may be simultaneously formed around the outer surface of the open end of the fiber shell, while the taper is imparted thereto. Thus, it will be seen, that near the lower end of the segments **33** I have provided an external rib **39** extending around the periphery a spaced distance from the lower end. These ribs **39** cooperate with a recess **40** formed in the female die **41** surrounding the lower end of the form so that a rib of the desired smooth configuration is formed around the outer surface of the shell.

In using apparatus of the type shown in FIGS. 10 and 11, the expanding cam **37** is shifted downwardly and the segments are shifted inwardly so that the form is in its contracted position. A fiber shell made of convolutely wound laminated layers of kraft paper with the paper or fiber in stretchable, deformable condition is then assembled around the form, as shown in FIG. 11. The cam **37** is then shifted upwardly to shift the segments outwardly and expand the tapered form exerting force relatively between the form and the fiber shell to cause the lower end of the fiber shell as viewed in FIG. 11 to expand outwardly and conform in taper with the form and assume the configuration thereof with a stacking rib formed around the outer surface thereof. Due to the fact that the paper or fiber is in stretchable, deformable condition, the shell will assume the tapered configuration without rupturing the fibers and with the inner and outer surfaces of the shell maintaining a smooth appearance. When the tapered shell has been thus formed, the cam **37** is shifted downwardly and the segments are shifted inwardly to contract the form. The female die ring **41**, which is hinged on one side and releasably fastened on the other, is then opened. Thereafter, the tapered shell can be shifted upwardly and removed from the apparatus. A new shell of uniform cross-sectional dimensions from end to end and with the paper or fiber in stretchable or deformable condition is then assembled around the contracted form.

The tapered fiber shell, thus formed, can be made into a container by inverting it so that the narrowest end becomes the base. The closure is permanently secured to the lower narrowest end thereof and the open end is left in open condition to receive a removable closure of any desired type. Containers of this type may then be efficiently stacked in nested relationship, as shown in FIGS. 2 to 9.

In FIGS. 12 and 13 we have illustrated a further procedure for making a tapered fiber container body by expanding into tapered configuration a fiber shell which is initially of uniform dimensions from end to end. Under this procedure, I place the shell inside a tapered form so that the outer surface of the shell is disposed adjacent the tapered form, and then a force is applied to the inner surface of the shell by hydraulic pressure to impart a taper to the shell and cause it to assume the configuration of the form.

Thus, in FIGS. 12 and 13 we have shown a metal form **45** which tapers gradually and substantially uniformly from its lower end to its upper end. The form is provided with a base plate **46** extending across the bottom, and a top plate **47**. The form is made in two longitudinal extending half sections, as shown, which are hinged together at one side, as shown at **48**, and which are provided with a releasable catch **49** on the diametrically opposite side. Thus, the catch **49** may be released and the two half-sections pivoted to open position around the hinge **48** so that a fiber shell **30** may be inserted therein. Inside the form is a flexible, impervious, inflatable envelope or bag **50** made of natural or synthetic rubber or a suitable impervious, flexible, plastic material. The bag **50** has an opening at its lower end which is connected by a conduit **51** to a source of hydraulic fluid under pressure (not shown). The fiber shell is assembled around the envelope **50** and the two halves of the form **45** are closed and the catch **49** is engaged.

The fiber shell **30** is of substantially uniform dimensions from end to end. At the time of its insertion in the form, the paper or fiber material is in stretchable, deformable condition. In this connection, it is preferably made from extensible kraft paper of the type defined above.

After the shell has been assembled in the form as shown in FIG. 13, the source of hydraulic fluid is connected with the envelope **50** so that hydraulic fluid under pressure inflates the envelope and exerts a force against the inner surface of the shell, as shown by the arrows in FIG. 13. The shell is thus gradually expanded into engagement with the inner surface of the form, thereby imparting a taper to the shell and causing it to assume the configuration of the form. In this connection, the form is preferably provided with a groove **52** extending around the inner surface of the form, adjacent but spaced from the lower end thereof, as shown in FIG. 13. Thus, when the shell is expanded into engagement with the form, a stacking rib will be formed around the outer surface of the shell adjacent the larger end thereof.

When the tapered shell has thus been formed, the form **45** is opened and the tapered shell is removed therefrom. A new shell with the fiber in stretchable, deformable condition is then inserted inside the form and the operation is then repeated. The tapered shell is inverted and completed into a container body, as described above in connection with FIGS. 10 and 11.

In FIGS. 10 to 13 I have shown preferred embodiments of my invention in which a fiber shell having paper or fiber in stretchable, deformable condition, is expanded into tapered configuration. While this is the preferred procedure, I may also, under certain circumstances, form the tapered shell by contracting a fiber shell into tapered configuration.

Thus in FIGS. 14 to 17 I have illustrated both mechanical and hydraulic procedures for contracting a shell of uniform dimensions from end to end into tapered configuration.

In FIGS. 14 and 15, I have illustrated a mechanical

procedure for thus contacting the fiber shell into tapered configuration. The apparatus comprises inner and outer forms or dies 55 and 56, both of which are expandable and contractable.

Thus, each of the dies are made of a plurality of segments. In the illustrated embodiment, they are each made of four segments. The form or die 55 is similar to that shown at 32 in FIGS. 10 and 11, and it may be expanded by shifting the segments outwardly and may be contracted by shifting the segments inwardly. A tapered expansion cam similar to the cam 37 may be provided for shifting the segments outwardly and for retaining them in expanded condition. The cam is engageable with the tapered inner walls of the segments.

The outer form or die 56 is also made of four segments, which shift inwardly and outwardly in the direction of the arrows, so as to contract or expand the outer form.

The outer walls of the inner form 55 and the inner walls of the outer form 56 are tapered in complementary fashion so that when a fiber shell is interposed therebetween, and the outer form is contracted, the desired tapered configuration will be imparted to the shell. In addition, the inner form 55 is provided with a rib 57 extending around the periphery of the lower portion thereof, and the outer form 56 is provided with a corresponding groove to receive the rib. Thus, when the outer die or form is contracted, a stacking rib will be imparted to the fiber shell adjacent the end thereof.

The forms are supported on a base plate 59 and a top plate 61 extends over the upper end of the inner form 55 and is secured to the base plate 59 by suitable rods or frame members 62.

In using the apparatus shown in FIGS. 14 and 15, a fiber shell 60 of uniform cross-sectional dimension from end to end and with the paper or fiber in stretchable, deformable condition is inserted between the two forms as shown most clearly in FIG. 15. The outer form 56 is then in expanded condition. At the time that the shell is inserted between the forms, the inner form 55 may be in contracted condition, but is then shifted to the expanded condition shown in FIG. 15. Thereafter, the outer form is contracted therearound so as to contract the upper end of the shell, as shown in FIG. 15, and impart a taper thereto causing it to assume the configuration of the expanded inner form 55. Simultaneously, a stacking rib will be formed around the shell near the larger end thereof. Thereafter, the outer form 56 is expanded and the inner form 55 is contracted so as to release the tapered shell therefrom. The tapered shell can then be withdrawn and can be inverted and then finished in the manner described in connection with FIGS. 10 and 11.

A new shell can then be inserted between the forms and the inner shell expanded, and the operations described above can again be repeated.

In FIGS. 16 and 17 I have illustrated the procedure that may be followed in contracting a fiber shell of uniform diameter into the desired tapered configuration by means of hydraulic force. Thus, I have provided an expandable and contractable central form or die 55 similar to that shown in FIGS. 14 and 15, around which the fiber shell is assembled and against which it is contracted into tapered configuration. The form 55 tapers gradually in cross-sectional dimensions from its lower end to its upper end, and is provided with an external rib 57 extending around the periphery thereof a short distance from the lower end. The form is supported on a base plate 65 so that the segments can shift inwardly and outwardly to contract and expand the form.

The apparatus also has side walls 66 disposed around the outer edges thereof spaced from the form 55. Extending across the top of the side walls 66 is a cover plate 67 which is hinged to the walls along one side, as shown at 68, so that it may be pivoted upwardly to expose the interior so that the shell can be inserted and also pivoted to the closed position shown in FIG. 17. A latch assembly may be provided on the side of the cover opposite the hinges 68, as shown at 69, for firmly and securely retaining the cover in closed position.

Immediately inside the walls 66 and extending completely there around is the annular envelope 71. The envelope is made of flexible, impervious material so that it can be hydraulically inflated. Thus, it may be made of natural or synthetic rubber or a flexible plastic material. The envelope is connected by one or more conduits 72 to a source of hydraulic fluid under pressure whereby the envelope may be inflated.

In using the apparatus shown in FIGS. 16 and 17, the cover plate 67 is opened and a tubular fiber shell 70 is inserted therein and assembled around the form 55. While the envelope 71 is in deflated condition, and preferably while the form 55 is contracted, cover plate 67 is then closed and the latch 69 is securely fastened in place. Thereafter, form 55 is expanded by shifting the expanding cam to its uppermost position. Envelope 71 is then inflated by connecting conduit 72 to a source of hydraulic fluid under pressure. Since the envelope is confined between the outer walls 66, base plate 65, and cover plate 67 the force exerted by the hydraulic fluid serves to contract the tubular fiber shell inwardly against the form 55 causing it to assume the tapered configuration thereof.

As in the other forms of my invention, the shell 70 is made of convolutely wound, laminated layers of kraft paper or fiber, and at the time that it is inserted in the apparatus to be compressed, the paper or fiber is in workable, deformable condition. Thus, it may be compressed into taper configuration and the rib formed therein without bursting the fibers and without unduly wrinkling the surfaces of the shell.

After the tapered configuration has been imparted to the shell, the pressure may be released from the envelope and the form 55 may be contracted. Cover 67 is then opened and the tapered shell may be readily removed from the apparatus to be finished into a container in the manner previously described. Another fiber shell with the paper or fiber in workable condition is then inserted in the apparatus and the operation repeated.

Thus, it will be seen that I have provided an improved fiber container, having a tapered, tubular container body made of convolutely wound laminated layers of fiber. Fiber containers of this type may be conveniently stacked in nested relationship and in order to prevent binding between the container walls, I provide projecting means on one surface of the container wall adjacent, but spaced from one end thereof, and adapted to have supporting engagement with the end portion of a similar fiber container nested therewith.

It will be seen that I have provided an improved method of making tapered fiber containers of this type, wherein I first provide a tubular fiber shell of uniform cross-sectional dimensions from end to end and with the paper or fiber in stretchable, deformable condition. I then place one surface of the shell adjacent a tapered form and apply a force between the shell and form so as to cause the shell to assume the tapered configuration of the form.

In a preferred embodiment of my invention, the tubular fiber shell is made of extensible kraft paper and the shell is expanded by a force applied against its inner surface so as to assume the tapered configuration of a form surrounding the outer surface of the shell.

In the procedure illustrated in FIGS. 10 and 11, and 14 and 15, it will be noted that the dies or forms are in segments with the result that the stacking ribs formed around the tapered fiber shells may be interrupted or discontinuous. However, this does not interfere with their intended function to provide supporting engagement with the under portion of a container stacked therewith so as to prevent the container walls from binding with each other.

It should be understood that modifications may be made in the illustrated and described embodiments of my invention without departing from the invention as set forth in the accompanying claims.

I claim:

1. The method of forming a tapered fiber shell for use in a tapered container body suitable for stacking in nested relation with other similar container bodies which comprises: first forming a tubular shell of substantially uniform cross-sectional size and shape from end to end from convolutely wound layers of fibrous material laminated together and then while the paper is in stretchable deformable condition placing one surface of the shell immediately adjacent a tapered form while applying a force between the form and the shell to cause the shell to conform in shape to the form and assume a tapered configuration increasing gradually and substantially uniformly in cross-sectional dimension from one end to the other.

2. The method of forming a tapered fiber shell for use in a tapered container body suitable for stacking in nested relation with other similar container bodies as set forth in claim 1 in which laterally projecting means are formed on one surface of the shell adjacent but spaced from one end thereof.

3. The method of forming a tapered fiber shell for use in a tapered container body suitable for stacking in nested relation with other similar container bodies which comprises: first forming a tubular shell from convolutely wound layers of fibrous material laminated together with a liquid containing adhesive and then prior to the setting of the adhesive while the fibrous material is still wet and in stretchable deformable condition placing one surface of the shell immediately adjacent a tapered form while applying a force between the form and the shell to cause the shell to conform in shape to the form and assume a tapered configuration gradually and substantially uniformly increasing in cross-sectional size from one end to the other end of the shell.

4. The method of forming a tapered fiber shell for use in a tapered container body suitable for stacking in nested relation with other similar container bodies which comprises: first forming a tubular shell from convolutely wound layers of extensible paper laminated together and then placing one surface of the shell immediately adjacent a tapered form while appyling a force between the form and the shell to cause the shell to conform in shape to the form and assume a tapered configuration gradually and substantially uniformly increasing in all cross-sectional dimensions from one end to the other.

5. The method of forming a tapered fiber shell for use in a tapered container body suitable for stacking in nested relation with other similar container bodies as set forth in claim 4 in which a closure is permanently secured to the end of the shell having the smallest cross-sectional dimensions and the end of the shell having the largest cross-sectional dimensions is left in open condition to receive a removable closure.

6. The method of forming a tapered fiber shell for use in a tapered container body suitable for stacking in nested relation with other similar container bodies as set forth in claim 4 in which the tapered form is disposed around the outside of the shell and the force is applied to the inner surface of the shell.

7. The method of forming a tapered fiber shell for use in a tapered container body suitable for stacking in nested relation with other similar container bodies as set forth in claim 4 in which the tapered form is disposed on the inside of the shell and the force is applied to the outer surface of the shell.

8. The method of forming a tapered fiber shell for use in a tapered container body suitable for stacking in nested relation with other similar container bodies as set forth in claim 4 in which the force is applied to the opposite surface of the shell by fluid pressure exerted through a flexible envelope.

9. The method of forming a tapered fiber shell for use in a tapered container body suitable for stacking in nested relation with other similar container bodies as set forth in claim 4 in which a circumferential rib is formed around the outside of the shell adjacent the end of maximum cross-sectional dimension.

10. The method of forming a tapered fiber shell for use in a tapered container body suitable for stacking in nested relation with other similar container bodies as set forth in claim 4 in which a circumferential rib is formed around the inner surface of the shell adjacent the end of minimum cross-sectional dimension.

11. The method of forming a tapered fiber shell for use in a tapered container body suitable for stacking in nested relation with other similar container bodies as set forth in claim 4 in which the tapered form is provided with a circumferentially extending off-set portion adjacent one end thereof so as to form a circumferential rib extending around the shell adjacent one end thereof.

12. The method of forming a tapered fiber container suitable for stacking in nested relation with other similar containers which comprises: first forming a tubular shell from convolutely wound layers of extensible paper laminated together, then disposing the shell inside a tapered form disposed adjacent the outer surface of the shell and applying a force to the inner surface of the shell to cause it to expand and to conform in shape to the form and assume a tapered configuration gradually and substantially uniformly increasing in all cross-sectional dimensions from one end to the other end of the shell, and finally permanently applying a closure to the end of the shell of smallest cross-sectional dimensions whereby the container may be stacked with other similar containers nested through the open end thereof.

13. The method of forming a tapered fiber container suitable for stacking in nested relation with other similar containers as set forth in claim 12 in which a projecting portion in the form of a circumferential rib is formed on one surface of the shell adjacent one end thereof for supporting engagement with the end portion of a container stacked therewith.

14. The method of forming a tapered fiber container suitable for stacking in nested relation with other similar containers as set forth in claim 12 in which the force is applied to the inner surface of the shell by fluid pressure exerted through a flexible envelope.

15. The method of forming a tapered fiber container suitable for stacking in nested relation with other similar containers which comprises: first forming a tubular shell from convolutely wound layers of extensible paper or the like laminated together, then disposing the shell around a tapered expansible form disposed adjacent the inner surface of the shell and while the form is in contracted condition, expanding the form so as to cause the shell to expand and to conform in shape to the form and assume a tapered configuration gradually and substantially uniformly increasing in all cross-sectional dimensions from one end to the other end of the shell, and finally permanently applying a closure to the end of the shell of smallest cross-sectional dimensions whereby the container may be stacked with other similar containers nested through the open end thereof.

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