United States Patent

[11] 3,586,084

[72] Inventor Sanford Redmond
383 Concord Ave., Bronx, N.Y. 10454
[21] Appl. No. 878,970
[22] Filed Dec. 5, 1969
[45] Patented June 22, 1971
Continuation of application Ser. No. 618,975, Feb. 27, 1967, now abandoned, Continuation-in-part of application Ser. No. 537,933, Mar. 28, 1966, now abandoned.

[54] **PLASTIC BLANK FOR MAKING A CONTAINER**
6 Claims, 14 Drawing Figs.

[52] U.S. Cl. 150/.5, 161/42
[51] Int. Cl. B65d 1/26
[50] Field of Search 150/.5; 161/41, 42, 44

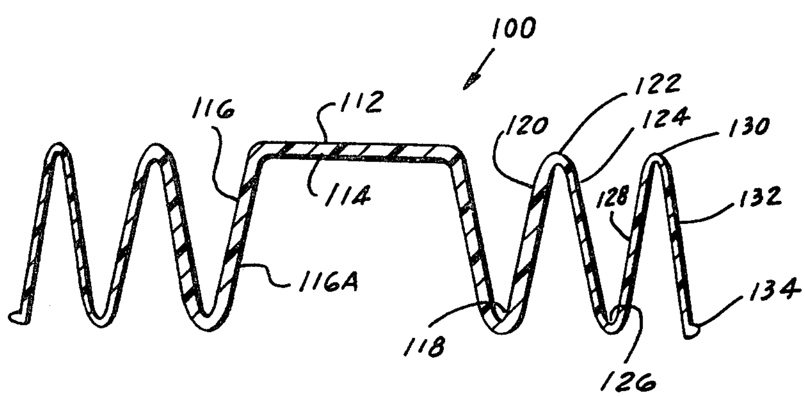
[56] **References Cited**

UNITED STATES PATENTS

2,880,902	4/1959	Owsen	150/.5 X
3,184,524	5/1965	Whiteford	264/94
3,220,544	11/1965	Lovell	150/.5 X
3,270,104	8/1966	Dreyfus et al.	264/92
3,298,893	1/1967	Allen	161/42

Primary Examiner—Donald F. Norton
Attorney—Morgan, Finnegan, Durham & Pine

ABSTRACT: This invention relates to the production of hollow plastic articles from a novel plastic blank having a central portion surrounded by at least one corrugation wherein the wall thickness of the blank is accurately controlled or programmed, and to novel methods for extending and expanding such a blank into the shape of the desired container by applying a deforming force to extend the blank to produce a hollow article having substantially the height desired for the final container, and, thereafter, applying heat and pressure to expand the extended blank laterally to produce the final shape of the desired container.



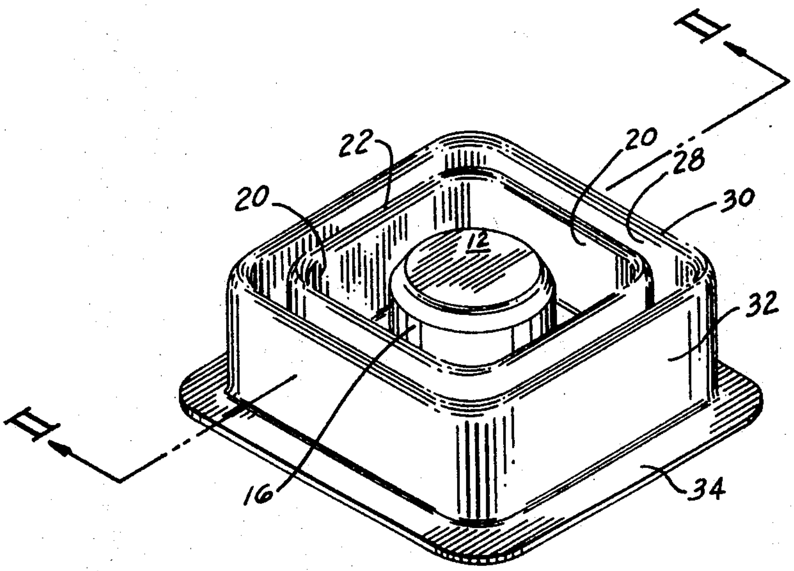


FIG-1

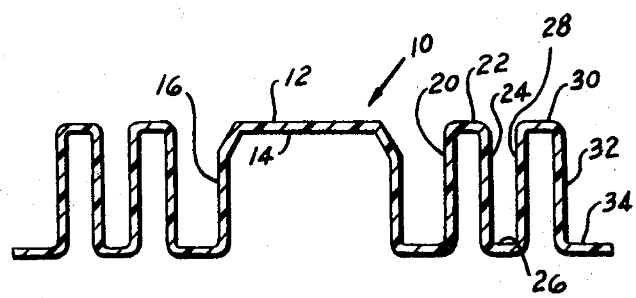


FIG-2

INVENTOR.
SANFORD REDMOND
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

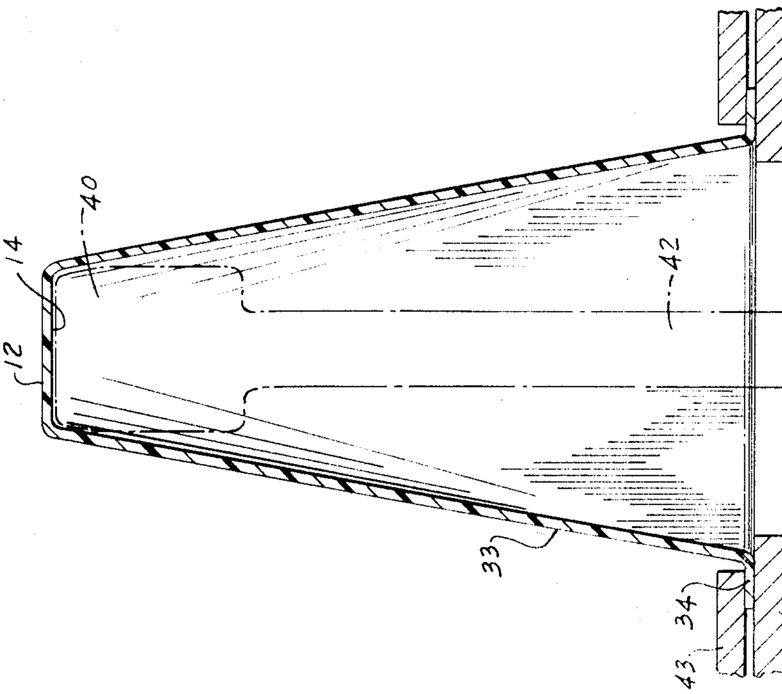


FIG-3B

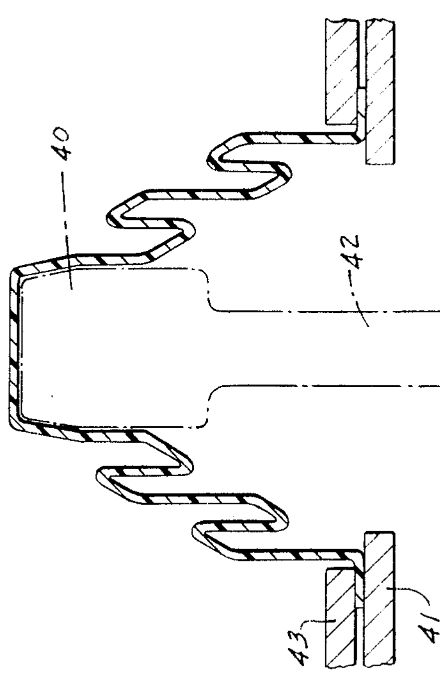


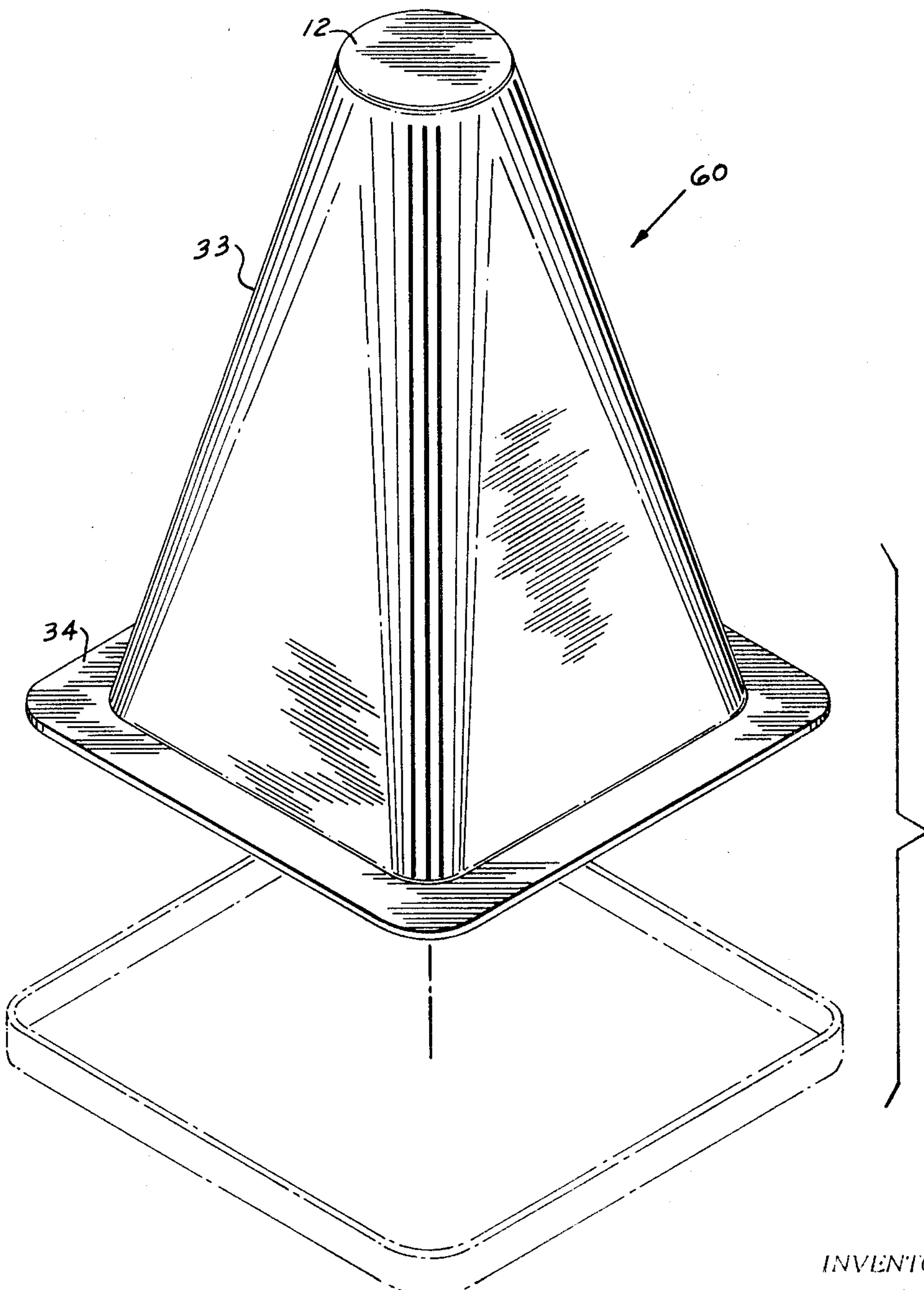
FIG-3A

INVENTOR
SANFORD REDMOND

BY

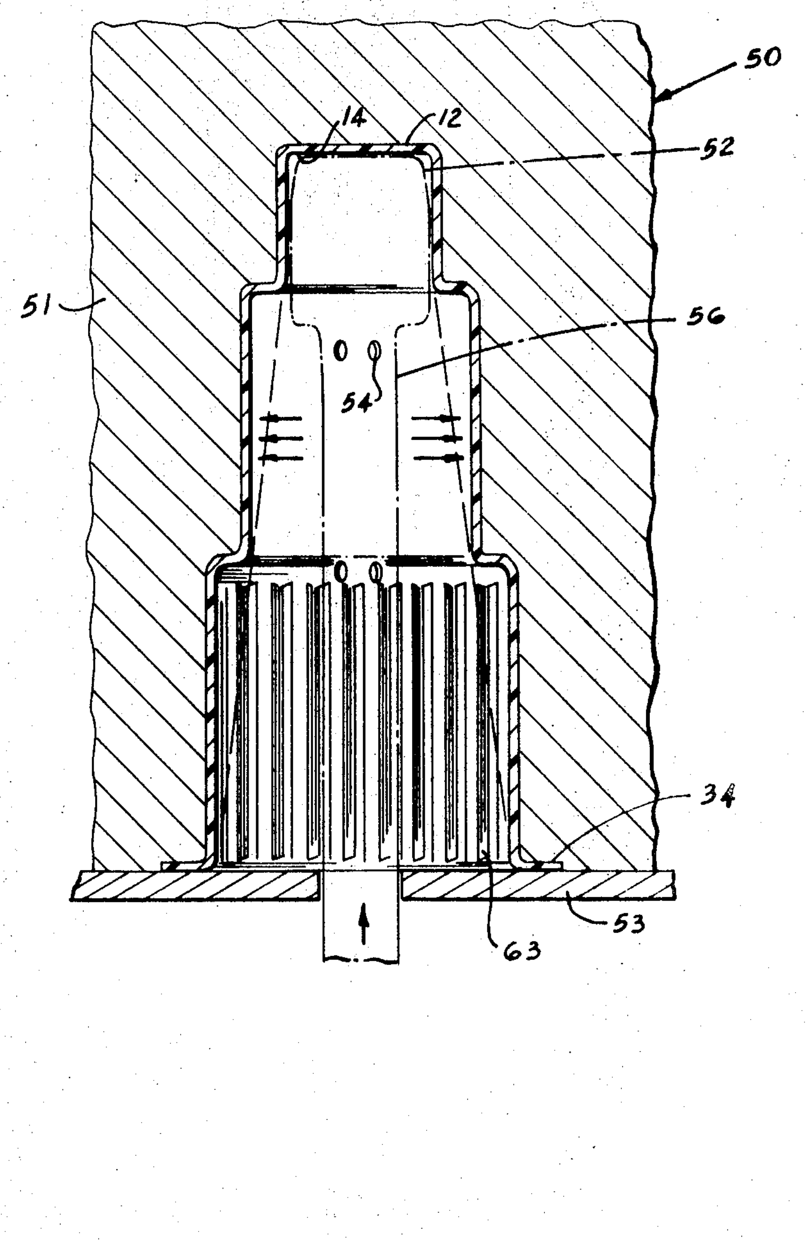
MORGAN, FINNEGA, DURHAM & PINE
ATTORNEYS

FIG-3C



INVENTOR.
SANFORD REDMOND
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

FIG-4



INVENTOR.
SANFORD REDMOND

BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

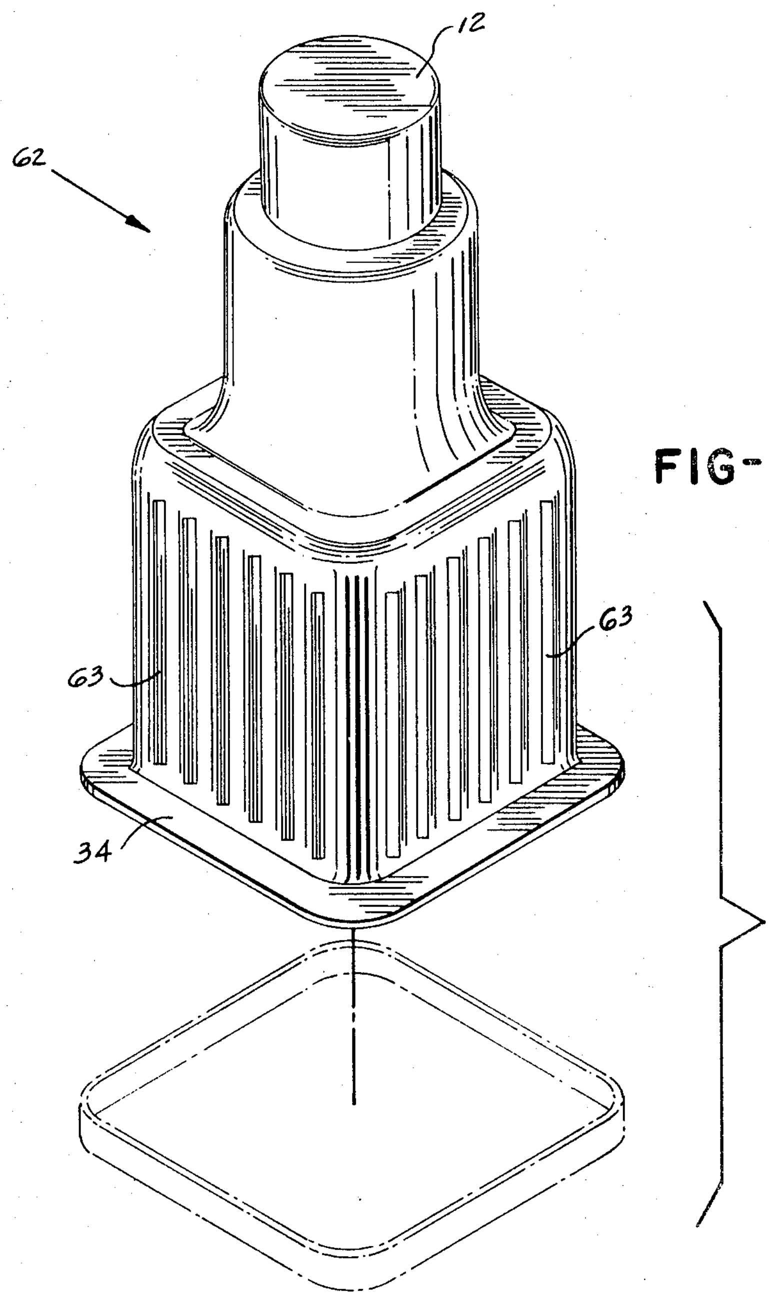


FIG-5

INVENTOR.
SANFORD REDMOND
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

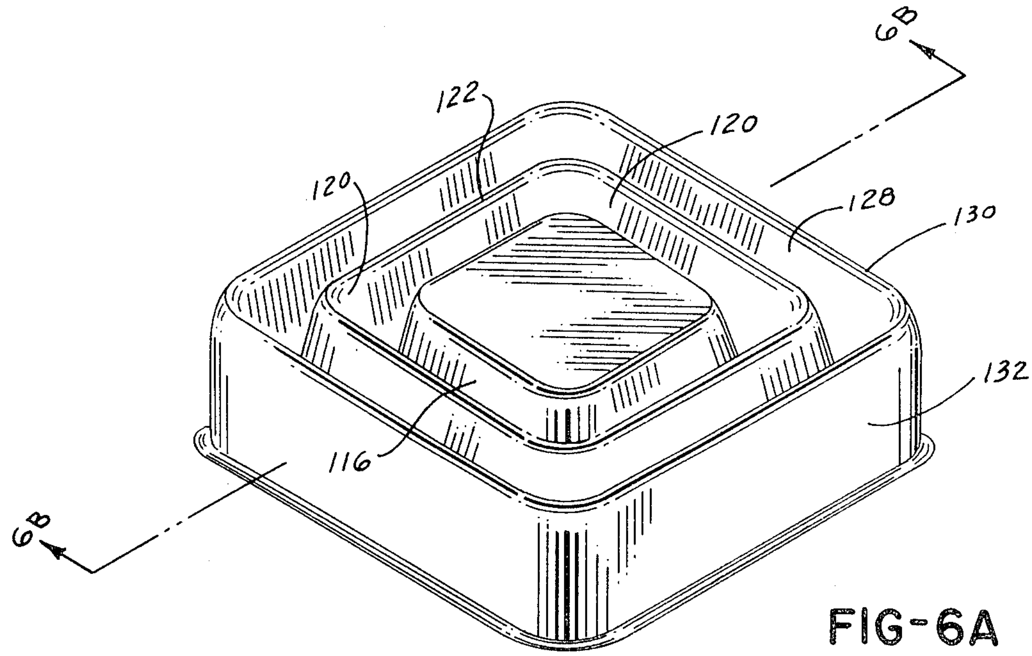


FIG-6A

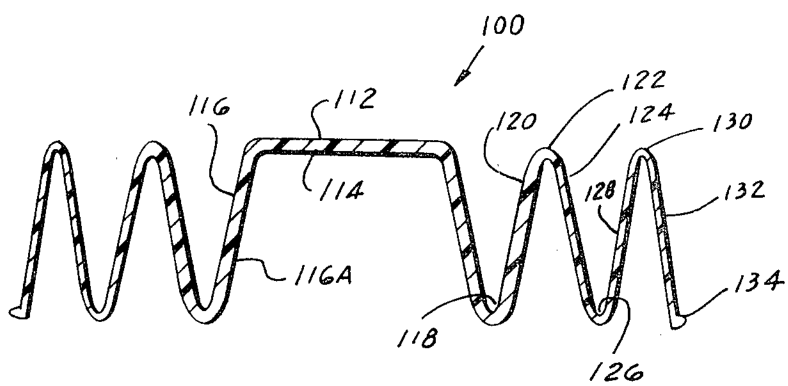


FIG-6B

INVENTOR.
SANFORD REDMOND
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

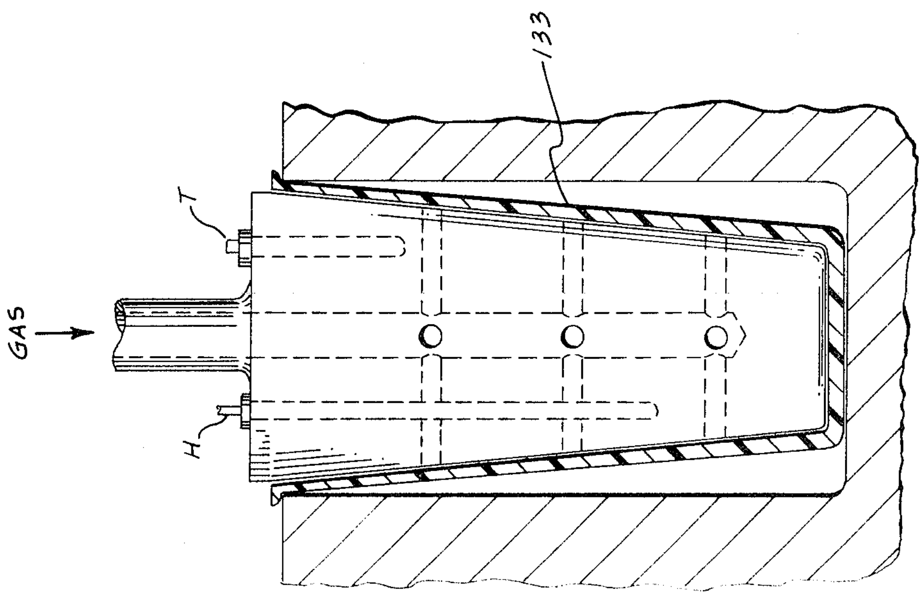


FIG-6D

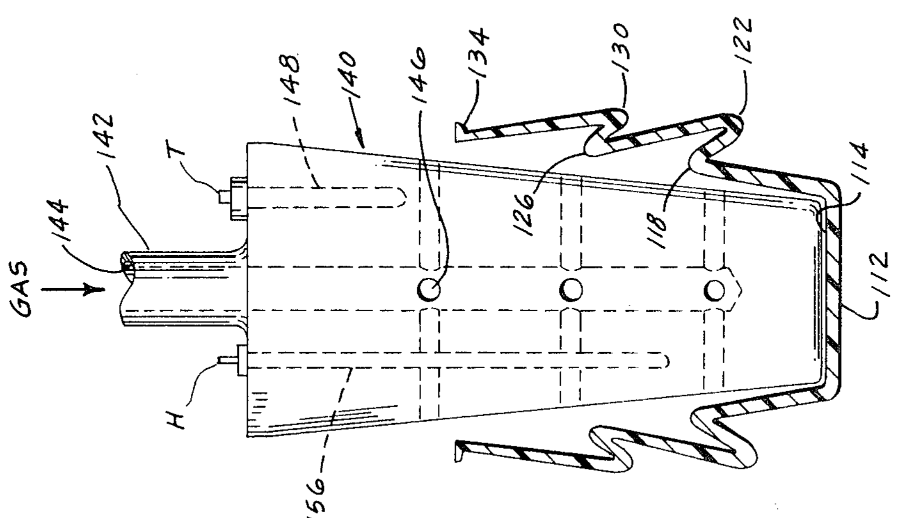


FIG-6C

INVENTOR.
SANFORD REDMOND
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

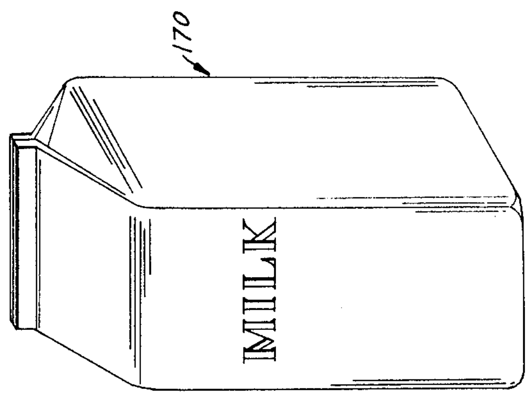


FIG-6G

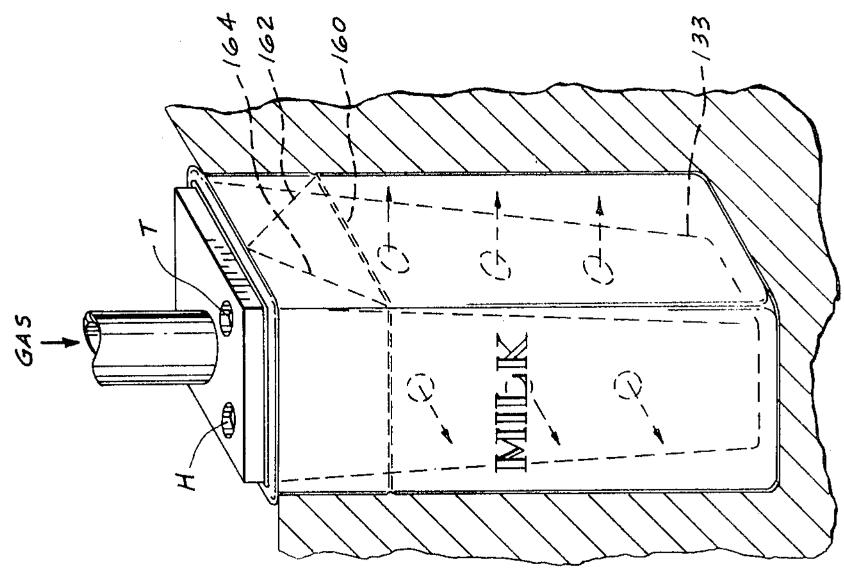


FIG-6F

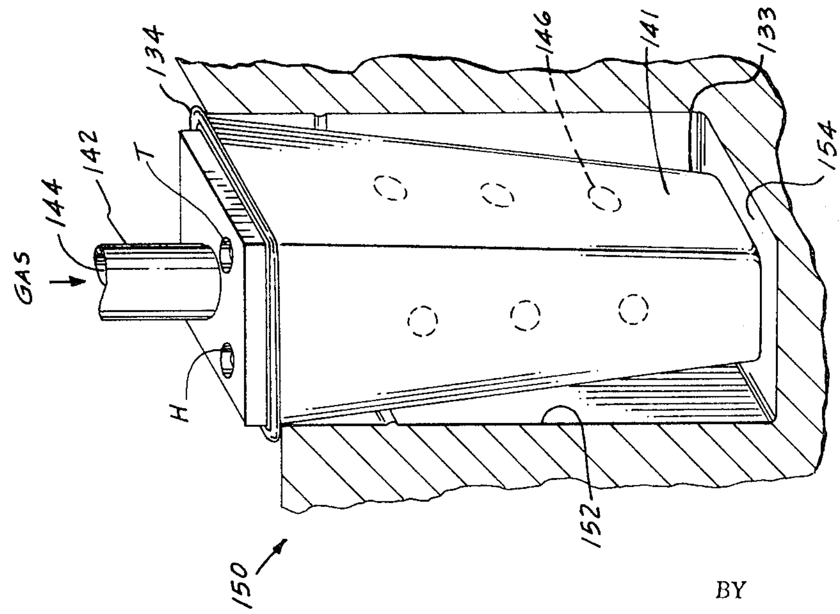


FIG-6E

INVENTOR.
SANFORD REDMOND

BY

MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

PLASTIC BLANK FOR MAKING A CONTAINER

This application is a streamlined continuation of application Ser. No. 618,975, filed Feb. 27, 1967, now abandoned, which in turn, is a continuation-in-part of application Ser. No. 537,933, filed Mar. 28, 1966, now abandoned.

Hollow articles, as bottles and other containers, have heretofore been prepared by various plastic-molding and forming techniques, such as injection molding, blow molding, and thermoforming of a plastic sheet by deep drawing. More recently, it has been proposed to form hollow containers from blanks or preforms of plastic materials made by injection molding, and which blanks are thereafter deformed to effect a flow and stretching of the plastic blanks into the desired shaped container.

While the aforementioned methods are capable of producing various types and shapes of plastic bottles and containers, they suffer distinct disadvantages which render them uneconomical and inefficient as respects the production of larger sized containers, as milk and beverage containers. In addition, the aforementioned methods are not usually adapted to high speed production of low cost containers. For these reasons, plastic coated paperboard has been favored in the packaging of milk, beverages and other products.

The costs incident to the production of bottles and containers by injection molding, blow molding, or thermoforming have not been considered prohibitive, in many instances, because the contents, on the whole, intended for such containers have been of such nature as to render the cost of the containers a relatively small factor in the overall pricing of the packaged product. Thus, injection and blow molded containers may readily be used in the packaging of drugs, cosmetics, and household maintenance materials where the value of the contents is relatively high, and, in general, the contents are dispensed or consumed over a substantial period of time on the order of weeks or months.

In contrast to the foregoing, when goods are intended for immediate consumption, such as milk and other beverages, the cost of the container and the efficiency at which it may be produced become highly significant factors. There have recently been several attempts to market milk and beverages in plastic containers, but while these containers were substantially leakproof, attractive and sanitary, the cost of producing them has been prohibitive and the marketing attempts have failed. The cost of producing a plastic milk container by these known methods is higher than that of making milk containers from plastic-coated paperboard, and this lower cost renders attractive the use of plastic-coated paperboard in spite of leakage and appearance problems.

In addition, the present molding and/or forming techniques for the manufacture of containers impose considerable problems of storage and transportation, especially as the container sizes increase, for the reason that these techniques, as now practiced, inherently have a low output rate, thereby requiring either the container manufacturer or his customer to maintain a large inventory of the containers. The manufacturer's inventory is required in order that he may meet his customers' demands without long delays, because of the low output of the molding techniques. The manufacturer's customer, on the other hand, requires large numbers of these containers in order to operate his filling machines at economical production rates, it being known that the filling machines can usually fill a container as fast or faster than the container can be made. The marked disparity between filling rates and container production rates by injection and blow molding techniques is such that even if the filler or packager made his own containers, he would still be required to maintain a large inventory of containers. If these containers were of quart size and larger, as are the common milk and beverage containers, the required storage space alone would impose significant overhead costs as would tend to render prohibitive the use of plastic containers for those products where the containers are made according to the heretofore known techniques.

In addition, the present molding and/or forming techniques, as heretofore practiced, inherently require greater amounts of plastic raw materials than would otherwise be required by reason of strength considerations. This disadvantageous aspect of these techniques is attributable to the unintended variations in the final wall thickness of the container produced by these techniques. Consequently, these processes waste plastic raw materials and necessarily increase the cost of the final product.

The more recent techniques of thermoforming plastic sheet material or first forming blanks and thereafter deforming the blanks to form the desired container, though possessing many advantages over the injection and blow molding processes, are still unable to produce plastic containers for milk and beverages on a competitive basis with the plastic-coated paperboard containers. The deformation of plastic blanks into containers has been proposed, for example in U.S. Pat. No. 3,184,524, granted on May 18, 1965. According to the process of this patent, a dish-shaped plastic blank or preform having a nonuniform cross section is subjected to thermoforming under the influence of opposed pressure applying pistons. The blank, according to this proposal, has a relatively thick bottom wall section with a relatively thin, substantially straight sidewall portion sloping upwardly from the thick bottom wall. During the thermoforming step of that process, the thickened bottom wall portion is caused to flow between the opposed pistons and serves as the primary source of plastic for the ultimate bottom and sidewall of the finished container. This process, though possessing advantages over injection and blow-molding techniques for forming containers, does not appear to overcome all of the defects which must be eliminated if high quality plastic containers are to be made in high volume and at low cost and thereby be competitive with milk and beverage containers now fabricated of plastic-coated paperboard. For example, the use of blanks having a nonuniform cross section requires complex drawing apparatus in order to thermoform a container from the blank, because the plastic must flow laterally during compression between the opposed piston faces and longitudinally, that is, parallel, to the rectilinear movement of the pistons. In addition, as the thickened bottom portion serves as the primary source of plastic there is the distinct probability that the final wall thickness of the container will not be uniform throughout, thereby resulting in a container having weakened zones. Alternatively, the blank will be made with excessive amounts of plastic as a hedge against this probability. In any event, the container is not likely to be competitive with plastic-coated paperboard containers, because they will not be of satisfactory quality or will be too costly. Furthermore, the complex thermoforming apparatus is not suited to highspeed operation, principally because the opposed pistons must be operated in a carefully controlled manner if proper thermoforming according to that process is to be achieved.

Another recent technique for forming hollow plastic articles is described in U.S. Pat. No. 3,270,104, granted on Aug. 30, 1966. According to this patent, a softened film of irradiated oriented plastic, such a polyethylene, is draped over a cup-shaped core. Vacuum is applied through the base of the core to draw the softened film into the core thereby producing a preform in the film web. This preform is indicated as substantially conforming to the core and has walls generally conforming to the inside and outside surfaces of the upstanding core. The preform may be considered as having a depressed center with a vertical wall in the form of a single convolution. After the preform of U.S. Pat No. 3,270,104 has cooled, a force is applied to the depressed center section of the preform to snap or popout the center section to extend the preform into a hollow article having about double the height of the mold. The inherent rigidity of the irradiated plastic permits the snapped or popped-out center section to remain in place.

The forming of hollow articles in accordance with U.S. Pat. No. 3,270,104 is subject to several significant disadvantages which are not present in my invention. The articles formed according to the vacuum and pressure techniques of the patent have sidewalls varying in their thicknesses, with thin portions and thick portions at various points throughout the entire article. There is no practical method described in the patent for controlling these variations. Thus, for example, the drawing of the heated and softened film into the core will tend to stretch portions of the film. This stretching will cause the film to be thinner at some points, so that when the cooled preform is expanded, thin sections will be located throughout the height of the article and will extend circumferentially about the article. In addition, the techniques of the patent are inherently inefficient as respects the optimum utilization of plastic raw material, because practice of these techniques would necessitate the use of films of sufficient thickness throughout to insure that, upon stretching of the film over the mold, the final thickness would correspond to the minimum usable wall thickness. Other undesired losses in plastic material would naturally result from the use of a preformed film web as the article, or the preform produced in the web, would have to be cut from the web. Further, the article which may be produced from the techniques of the patent would, of course, possess relatively simple shapes, most probably of circular configuration, and would not be suitable for secondary expansion to produce the more complex shapes, as those with corners.

I have found that hollow plastic containers of simple as well as complex shapes may be produced from a minimum amount of plastic raw material by utilizing a blank having a center portion surrounded by at least one corrugation and having an accurately controlled or programmed wall thickness. I have also found that a container having a complex configuration may be produced from blanks of the character described by, first extending the blank, and, secondly, heating and expanding the blank into the final desired shape. Accurately controlled or programmed wall thickness in accordance with my invention means that the portions of the blank which undergo the greatest amount of stretch in the final expansion of the blank into the desired final article have the greatest initial thickness. Thus, my invention permits the formation of plastic articles having rectangular shapes which involve corner and edge formations and avoids undesired zones of weakness or unduly thin or thick sections randomly located in the container. Neither of the two aforementioned patents describe techniques which are suitable for use in forming the rectangular shape which, as is known, is used in the milk container field.

It is a primary object of this invention to form plastic containers, suitable for containing and dispensing liquids and solid materials, at low cost and high speeds with an optimum utilization of plastic raw material and a minimum of waste.

It is another object of this invention to form sturdy, leakproof and attractive plastic containers which are provided with accurately controlled or programmed wall thicknesses.

It is a further object of this invention to provide preformed blanks which may thereafter be formed into sturdy, leakproof and attractive plastic containers having accurately controlled wall thicknesses throughout at low cost and high speeds.

It is still another object to provide preformed blanks of plastic materials which may be formed into sturdy containers by applying forming pressure to the blank and directly extending the blank in a direction substantially parallel to the action of the forming force and thereafter heating and expanding the extended blank to form a container having the final desired shape.

It is yet another object to provide unitary plastic blanks which may be formed into containers and which are easily handled and nestable for storage purposes.

It is a still further object of this invention to provide for the forming of plastic blanks into containers either at a place remote from the point of use or at the point of use.

It is yet a further object of this invention to provide a process by which unitary preformed plastic blanks may be made into sturdy, leakproof and attractive containers at high speeds on relatively low cost equipment and with the least amount of plastic raw material.

Briefly, the objects and advantages of my invention are attained by reason of a novel blank of plastic material which may be formed into the desired containers by relatively simple techniques. I have found that a blank having an accurately controlled material cross section and possessing a central portion surrounded by convoluted or corrugated portions may be directly formed into a container by the application of a simple force, whereby the convolutions or corrugations are extended and opened into a container approximating the shape for which the blank was intended. I have also found that containers having complex shapes, including rectangular containers, may be produced from my blanks by first applying a simple force to extend the blank, and thereafter applying heat and pressure to expand the blank into the final desired shape.

Other objects and advantages will become evident to those skilled in the art from the description of the invention taken in conjunction with the accompanying drawings illustrating various embodiments, in which:

FIG. 1 is a view illustrating one form of the novel blank according to this invention;

FIG. 2 is a cross section of the blank illustrated in FIG. 1, taken along line II–II;

FIGS. 3A and 3B schematically illustrate one method by which the blank of FIG. 1 may be formed into a container, with FIG. 3A showing initial deformation of the blank and FIG. 3B showing the form of the container upon completion of deformation;

FIG. 3C illustrates a typical container which may be made by the method shown in FIGS. 3A and 3B;

FIG. 4 is another illustrative method by which the blank of FIG. 1 may be formed into a container;

FIG. 5 illustrates a typical container which may be made by the method shown in FIG. 4;

FIG. 6A illustrates another form of a blank according to this invention;

FIG. 6B is a cross section of the blank illustrated in FIG. 6A, taken along line 6B–6B;

FIGS. 6C, 6D and 6E schematically illustrate a method by which the blank of FIG. 6B may be formed into a rectangular container, with FIG. 6C showing initial deformation of the blank, FIG. 6D showing the extended blank at the end of the initial deformation, and FIG. 6E showing the extended blank prior to secondary expansion;

FIG. 6F schematically illustrates the formation of the final shape at the end of the secondary expansion; and

FIG. 6G illustrates the final form of a container which can be produced using a blank such as that of FIG. 6A and the methods illustrated in FIGS. 6C—6F.

Referring to FIG. 1, there is illustrated a blank formed in accordance with one aspect of the concept of my invention. For purposes of illustration only, the description of my invention will be given with respect to the formation of milk containers. While three types or shapes of containers are shown in the drawings (FIGS. 3C, 5 and 6G), it should be understood that many different types and shapes may be made.

The blank of FIG. 1, generally designated 10, is provided with a centrally disposed portion 12 having a depending skirt 16.

The blank of my invention may be formed from polyethylene, polypropylene or any other suitable plastic material. Any of the known methods for forming or molding these plastic materials, as, for example, the injection molding, may be used to prepare the blank 10.

The blank is formed with a plurality of convolutions or corrugations surrounding the central portion, as illustrated in FIGS. 1 and 2. Preferably, the blank is formed as a unitary structure with the skirt 16 leading into a base portion 18, an upstanding wall 20 turned down upon itself as at 22 to form wall 24 and another convolution beginning with a base portion 26, wall 28, bend 30, wall 32, and terminating at its lower end in a flange or rim 34.

It should be understood that the term convolution or corrugation, as used here, is intended to include pleats, folds, and other configurations capable of being extended in accordance with the concept of my invention.

It will readily be appreciated that the blank **10**, as well as blanks having the shape of blank **100**, may be superimposed on a similar blank to form a compact nest of blanks which may be conveniently stored until ready for use, or may be conveniently shipped from the molder to a point of use, such as the plant of a bottler or filler, who, in turn, may form the blank into the container, as will hereafter be described.

The central surface **12** is so dimensioned and is of such configuration as to readily lend itself to forming the base or bottom of the desired container to be formed from the blank. The vertical dimensions of the blank and the number of corrugations or convolutions are determined by the desired height of the container. Thus, for example, the linear measurement of the depending skirt **16**, bases **18** and **26**, upstanding walls **20**, **24**, **28**, **32** and the curved portions **22** and **30** will substantially equal the height of the ultimate container to be formed from the blank. The flange **34** serves as the rim of the ultimate container to which a separate cap may be affixed to seal the top of the container (see FIGS. **3C** and **5**).

According to one embodiment of this invention, the material cross section of the blank **10** is controlled throughout so that upon application of the forming force, there is substantially little requirement for lateral plastic flow from any portion of the blank. Instead, the container is formed by the application of force against the central surface **12** while the rim is held firmly in a forming mold, whereby the blank is expanded, in a controlled manner, in the direction of the forming force to extend the convolutions and, in effect, straighten them to form upstanding sidewalls of the container. In this manner, I am able to fabricate a container from a unitary blank and obtain a container having a controlled wall thickness.

The forming of the blank in accordance with this invention is illustrated in FIGS. **3** and **4**.

To expand the blank into a container, necessary areas of the blank may be heated. The blank, or any portion of it, may be heated by any of many known means. Preferably, heat is applied against the convolutions encircling the central portion, with the central portion **12** remaining unheated. In this way, the surface **12** will offer greater resistance during forming and will readily permit the blank to be expanded into the desired container by a straightening of the convolutions, If heat is utilized, it should be understood that the temperatures employed in heating the blank, and, more specifically, the convolutions, should be sufficiently below the melting temperature of the plastic material utilized so as to preclude incipient melting, all as is well known to those skilled in the art.

To expand the blank **10** into a container, rim **34** is firmly clamped between the mating surfaces **41**, **43** about the entire periphery of the rim. An extendible mandrel having a head **40** and shank **42** is thereafter inserted into the blank and forced against the inner surface **14** of the central portion **12**. As the mandrel is forced against this surface, it will be readily understood that the convolutions or corrugations will be straightened and extended to result in a container whose configuration is that desired.

In FIG. **3A**, the shape of the blank is schematically illustrated shortly after the mandrel head has begun to apply the deforming force against surface **14**. The corrugations are beginning to straighten in the direction of mandrel movement as the deforming force is applied. FIG. **3B** shows the mandrel head at the end of its stroke and no corrugations remaining, and with the wall **33** formed by the straightening of the corrugations.

In FIG. **4**, another well-known forming technique may be used to obtain containers having nonuniform cross sections in accordance with this invention. As there schematically illustrated, a blank **10** is firmly clamped in mold **50** so that the rim **34** is securely held about its periphery between surfaces **51** and **53**. A mandrel having a head **52** is inserted into the blank and urged against the inner surface **14** of the blank to extend and straighten the corrugations. After the mandrel head **52** acts against the surface **14**, gas may be introduced into the blank through ports **54** located in the mandrel shaft **56**. The gas pressure acting against the heated and softened walls will force the plastic into the internal configuration of the mold so as to form the desired shape, here, having ornamental flutes or folds **63**, and a stepped sidewall, as shown in the container **62** of FIG. **5**.

It should be readily appreciated that the blank in accordance with this invention provides for the fabrication of various size containers not limited to those for the handling of milk. The container may be of any desired size, because its dimensions may be accurately controlled. Closures may be made for each container, as illustrated in FIGS. **3C** and **5**.

Referring to FIGS. **6A** and **6B**, there is illustrated a blank formed in accordance with another aspect of the concept of my invention. The blank of FIGS. **6A—6B**, generally designated **100**, is provided with a centrally disposed portion **112** having a depending skirt **116**. Blank **100** of my invention may be formed from suitable plastic materials and by known methods as described with respect to blank **10**.

Blank **100** is formed with a plurality of convolutions or corrugations surrounding the central portion, as is illustrated in FIGS. **6A—6B**. Preferably, the blank is formed as a unitary structure with the skirt **116** leading into a bend **118** and upstanding wall **120** turned down upon itself as at **122** to form wall **124**, and another convolution beginning with a base portion **126**, wall **128**, bend **130**, wall **132**, and terminating at its lower end in a flange or bead **134**.

As is clearly shown in FIG. **6B**, the cross-sectional material thickness of the blank varies and is not uniform throughout. Thus, the central portion defined by the surfaces **112** and **114** possesses the greatest thickness and the thicknesses of the convolutions extending from the central portion diminish from the central portion to the bead **134**. The blank shown in FIG. **6B** illustrates schematically what is meant by accurately controlled or programmed wall thickness, for as will be described more fully hereinafter, the thickest section of the blank is located at that portion of the blank which will undergo the greatest expansion, whereas the convolutions, such as indicated by walls **132**, will expand the least, and, therefore, are thinner. It will be understood that the blank **10** of FIGS. **1—2** may be similarly dimensioned to provide thick and thin sections where desired.

As with blank **10**, the central surface **112** is so dimensioned and is of such a configuration as to readily lend itself to forming the base or bottom of the desired container to be formed from the blank. In addition, by reason of its increased thickness, it contains a sufficient amount of plastic material to permit lateral flow of plastic to fully expand the blank into the mold and form the desired shape of the final container.

The vertical dimensions of the blank **110** and the number of corrugations or convolutions are determined by the desired height of the final container. Thus, as was the case with blank **10**, the linear measurement of the convolutions, beginning with the depending skirt **116**, will substantially equal the height of the ultimate container to be formed from the blank. The bead **134** serves to secure the blank in the forming apparatus.

The forming of a container from blank **110** is schematically illustrated in FIGS. **6C**, **6D**, **6E** and **6F**. The shape of the blank **110**, its wall thicknesses, and the forming apparatus used are those which are intended to produce a milk container having a generally rectangular horizontal cross section, as illustrated in FIG. **6G**, such as is now commonly made of paperboard.

To expand the blank **110** into a container, the blank is placed in a mold provided with means (not shown) for firmly engaging the bead **134** to secure the blank in the mold. The mold, generally indicated as **150**, has four vertical interior walls **152** and a horizontal bottom wall **154**. The mold, consequently, has rectangular cross sections, both vertically and horizontally, and is intended to produce an open end, hollow article having a flat bottom and vertical upstanding walls.

The end of a mandrel, generally indicated as **140**, is then forced against the surface **114** of the blank to extend the blank longitudinally thereby straightening the corrugations or convolutions and producing a shape whose height corresponds to the linear measurement of the corrugations and substantially corresponds to the height of the ultimate container desired.

The mandrel 140 has a generally trapezoidal vertical cross section and rectangular horizontal cross sections, with the peripheral dimensions of the mandrel decreasing down the length of the mandrel. Thus, as shown in FIGS. 6D, 6D and 6E, the end of the mandrel adjacent surface 114 of the blank possesses the smallest peripheral dimension and corresponds generally in size to the opening in the blank formed by surfaces 116A of the depending skirt 116.

As the deforming force of the mandrel is applied to the surface 112, the corrugations begin to straighten as is clearly indicated in FIG. 6C. In FIG. 6D, the mandrel 140 has reached the end of the deforming stroke, and no corrugations remain, thereby forming a relatively smooth wall 133. It will be appreciated that the shape of the wall 133 corresponds to the shape of the mandrel and does not, at this point of the process, possess a shape corresponding to the interior surfaces 152, 154 of the mold.

During this cycle heat has been applied to the mandrel through any suitable means, generally indicated as H in FIG. 6E, through an appropriate bore 156. Gas pressure is also controllably supplied to the mandrel through the bore 144 in mandrel shank 142. The mandrel is also provided with suitable means, indicated generally by the letter T, located in the mandrel as at 148 for sensing and controlling the temperature of the mandrel.

The heat applied to the mandrel softens the wall 133 of the shape surrounding the mandrel while the gas pressure subsequently applied against the interior of the wall through ports 146 expands the shape laterally to completely fill the mold. The heating and expansion of the extended blank completes the formation of the rectangular container. The surfaces of the mandrel may, of course, be coated with a release agent, such as polytetrafluoroethylene, to assist in the removal of the extended blank from the mandrel by gas pressure.

The thickened central portion of the blank 110 contains a sufficient supply of plastic material to permit lateral flow of the material into the lower corners of the mold. The thinner sections of blank 110, corresponding in the extended and expanded state of the blank to the upper end of the container, do not undergo as great an expansion as the lower end, and, therefore, there is little demand for additional plastic in these areas. Thus, the blank of this invention with its accurately controlled or programmed thicknesses contains the plastic material in the amounts ultimately required in the proper sections of the blank, thereby permitting optimum utilization of the plastic material.

To facilitate closure of the container, the interior surfaces of the mold 150 may be provided with embossing surfaces to form the fold lines generally indicated at 160, 162 and 164. The interior of the mold may also be provided with embossed surfaces which serve to form words, such as "MILK" shown in FIG. 6F, in the softened plastic wall as it is expanded against the walls of the mold. The rectangular container of FIG. 6F may thereafter be filled and closed, as by heat sealing, stapling, etc., to form a rectangular milk container indicated as 170 in FIG. 6G.

It should also be appreciated that by forming the blank of a controlled material thickness, dimensioning the central portion 12 or 112 to relate to the desired size and configuration of the bottom of the container to be produced, and selecting the number of convolutions or currugations, as well as their respective heights, I am able to provide a self-contained blank which represents, in compact form, the final container to be obtained on forming of the blank. Thus, one end of the container is represented by the central portion, as 12, and the longitudinal height of the container by the linear measure of the convolutions or corrugations which surround the central portion.

The application of a force against the central portion, with the rim of the blank firmly secured, will cause the blank to be expanded in a controlled manner to obtain a container whose wall thicknesses are carefully controlled, by reason of the initial thickness of the blank and the length of the stroke of the mandrel, with as little or as much lateral flow of the plastic as is desired. The secondary expansion by the application of gas pressure and heat permits the extended blank to be formed into complex shapes with the minimum of plastic material.

It can be appreciated that the secondary expansion of the extended blank may be accomplished by the application of heat and the application of force through a mandrel which is formed in several sections and is adapted to expand. Thus, instead of gas pressure to permit the lateral expansion, the force derived from the spreading of the mandrel segments would be utilized.

The ease with which containers may be made from my blanks readily permits the installation of an integrated system to be installed at the filler or bottler's plant. In a first stage, the blanks may be made to conform to the desired container. Numerous blanks may easily be made, to example, in multiple molds. In a second stage, the blanks may be controllably heated under a bank of radiant energy sources, and thereafter fed to a forming station. Subsequently, the containers may be fed to a filling station to be filled and closed. The ease with which the blanks may be made and deformed permits each stage to be performed in timed relation to the next, from blank-forming to container filling, without unduly hampering the speeds at which the filling is accomplished.

Although the invention has been described with particular reference to specific embodiments, the same are not to be construed as in any way limiting the invention. Reference is, therefore, to be had solely to the appended claims for the purpose of determining the scope of the invention.

What I claim is:

1. In a plastic blank having a controlled wall thickness for use in the manufacture of a hollow plastic container having predetermined desired dimensions and a desired configuration, said blank comprising: a central portion surrounded by at least two corrugations, each of said corrugations extending circumferentially around said central portion and being spaced from the other corrugations, the minimum cross-sectional material thickness of said corrugations at the periphery of said blank being substantially equal to the predetermined wall thickness dimension of the container to be produced from said blank the cross-sectional thickness of said corrugations increasing from said minimum thickness to a maximum thickness where the intermost of said corrugations joins said central portion whereby the container formed upon extension and expansion of said corrugations has a relatively constant wall thickness throughout.

2. The plastic blank of claim 1, wherein the thickness of the central portion is greater than the thickness dimension of any other section of said blank.

3. The plastic blank of claim 1, in which the number of corrugations and the height of said corrugations of said blank are such that the linear measure of the corrugations substantially equals the height of the container to be formed from said blank.

4. The plastic blank of claim 1, in which the corrugations farthest removed from said central portion terminates in a rim encircling said blank.

5. The plastic blank of claim 1, in which the central portion is raised from the base of said blank.

6. The plastic blank of claim 1, in which the relationship of the central portion to the surrounding corrugations is such that one blank may nest on a similarly configured blank.