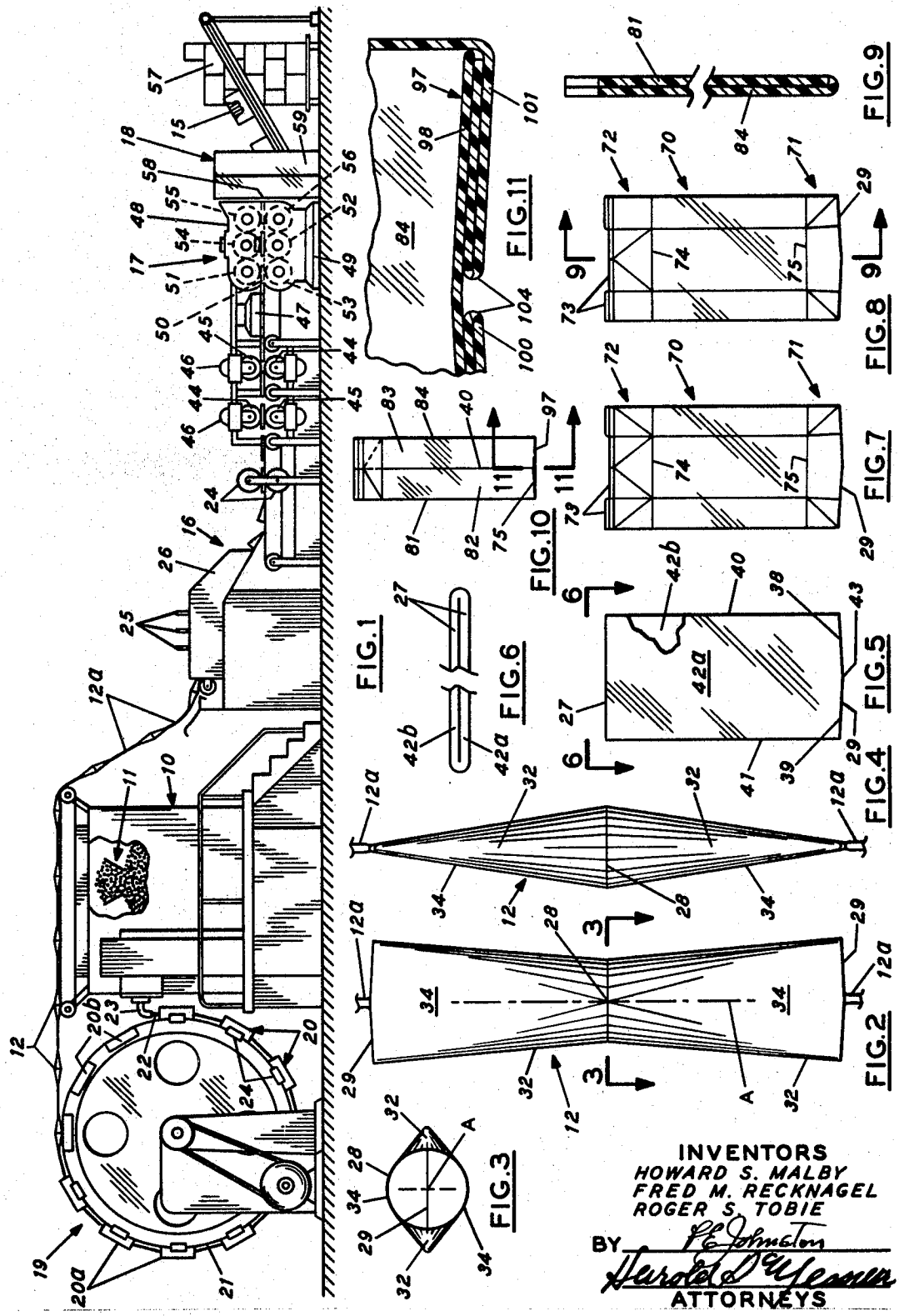
July 2, 1968 H. S. MALBY ET AL 3,390,829

HIGH-STRENGTH CONTAINER AND CONTAINER BLANKS HAVING SEAMLESS BOTTOM WALLS

Filed April 5, 1966 3 Sheets-Sheet 1



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HIGH-STRENGTH CONTAINER AND CONTAINER BLANKS HAVING SEAMLESS BOTTOM WALLS

Filed April 5, 1966 3 Sheets-Sheet 2

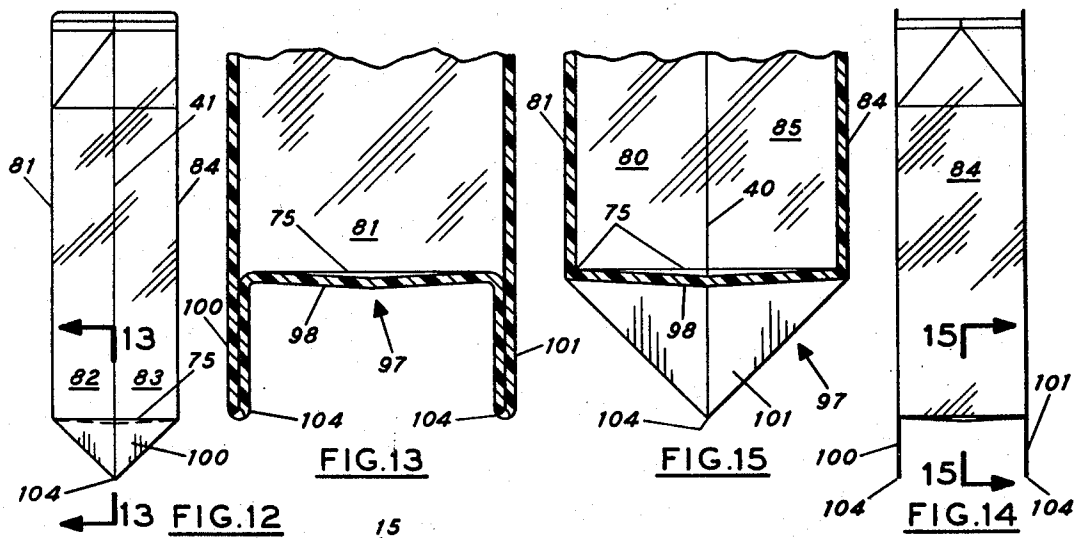


FIG.12 FIG.13 FIG.15 FIG.14

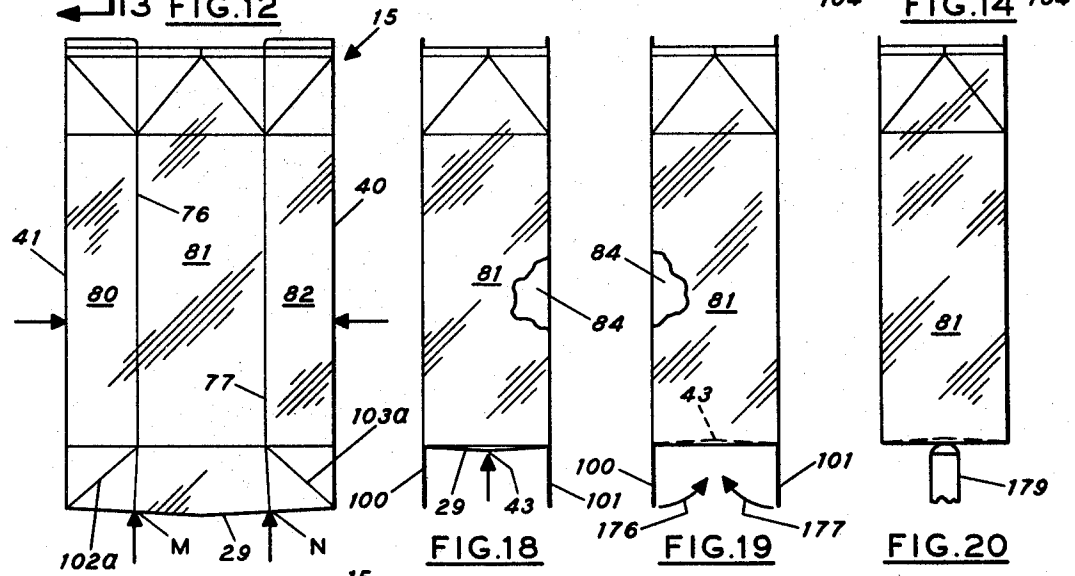


FIG.17 FIG.18 FIG.19 FIG.20

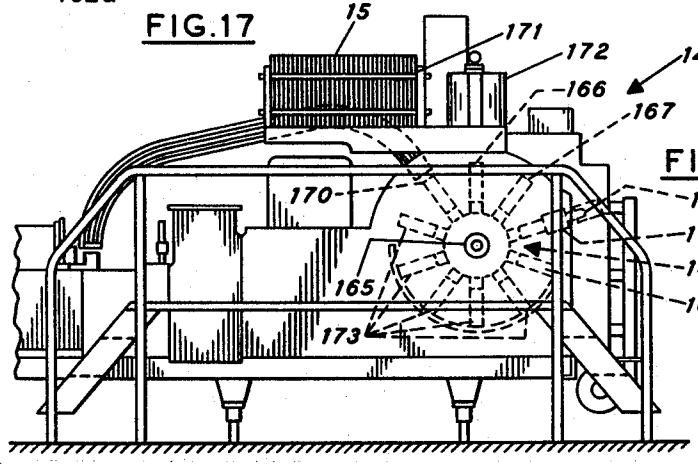


FIG.16

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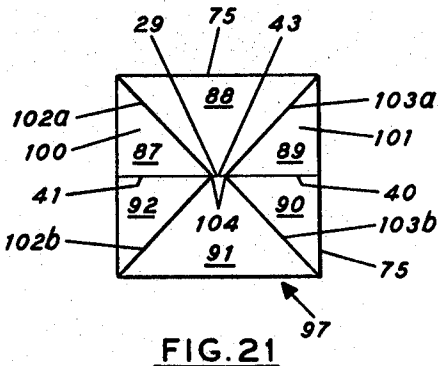


FIG.21

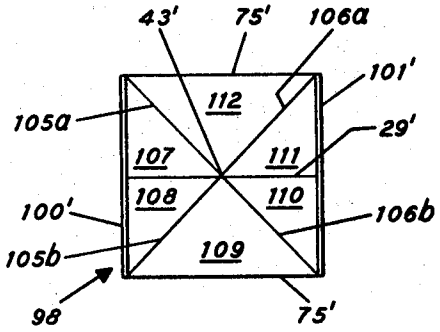


FIG.22

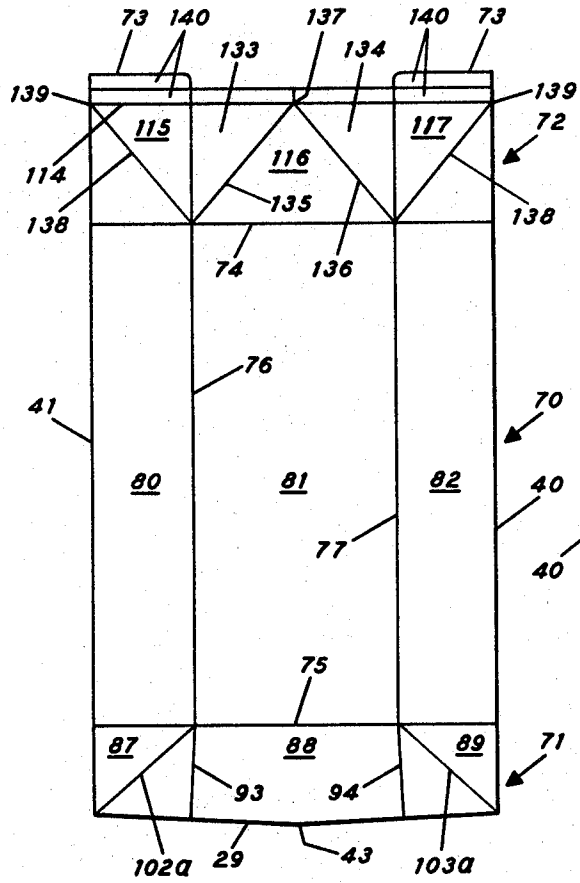


FIG.23

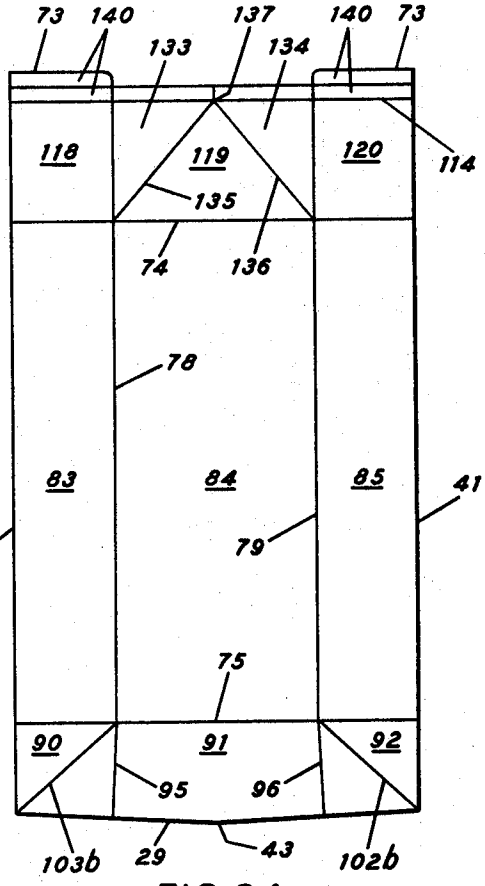


FIG.24

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3,390,829

HIGH-STRENGTH CONTAINER AND CONTAINER BLANKS HAVING SEAMLESS BOTTOM WALLS

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11 Claims. (Cl. 229—61)

ABSTRACT OF THE DISCLOSURE

A container and container blank for forming same, the container and blank being formed of plastic materials or the like and adapted to provide a fluid-tight seamless lower bottoming area; said blank having a series of fold lines dividing it into a series of panel areas and comprising first and second pentagonal planar side panels having parallel and coextensive broad surfaces integrally terminating in edge engagement with one another along first and second vertical side edges and a seamless, fluid-tight arcuate lower edge intersecting said side edges to allow the blank to lie flat for easy stacking, said first and second side edges being coplanar with said lower edge; said container being erectable from said blank and comprising a body member, a top closure engaging an upper edge of said body member, and a seamless bottom wall engaging a lower edge of said body member, said bottom wall comprising a central panel member reentrantly formed with respect to said body member having a pair of first opposed edges in integral engagement with said lower edge of said body member and a pair of second opposed edges transverse to said first edges, and a pair of double-ply tuck-up panels in simultaneous integral edge engagement with said lower edge of said body member and with said first edges of said central panel member.

This invention relates to the packaging of materials and, more particularly, to a seamless bottomed container constructed of plastics material or the like and foldable from a flat blank to an upright configuration of square or rectangular cross section for packaging of foodstuffs, such as milk.

The object of the present invention is to provide a low-cost container blank by the method of forming and erecting the blank to a fluid-tight container using a seamless and high-strength bottom construction in the initial, as well as final, steps of the formation of the blank. The container blank is foldable from the blank to a stable fluid-tight container of rectangular or square cross section without sealing mating edges along the bottom of the container. With the container blank of the present invention, it is now possible to produce an inventory of blanks at a centralized location manned by experienced personnel and to erect these container blanks into a sturdy container at a more remote field location using, for the most part, present fabrication machines without the addition of complicated sealing mechanisms for the bottom edges of the blanks.

Various aspects of the present invention include the method of manufacturing the container blank and erecting the blank to a completed container, as well as the apparatus aspects of the blank and container resulting from the method of the present invention.

Heretofore, containers have been manufactured from flat blanks of paperboard coated with plastics material; the blanks have been formed from sheets of the coated paperboard stock. These sheets are scored along their surfaces in an appropriate manner to define a desired form

of container blank. Initially, the blanks are left open along several of their mating edges. Obviously, the mating edges must be sealed, as along the vertical side, the bottom and the top of the blank, to form a sealed container. This sealing operation performed on the mating edges is not a continuous operation but usually progresses by stages. The side wall and bottom mating edges are sequentially joined to form a fluid-tight enclosure open at its top; the container is then filled with a fluid, such as milk, or, in some cases, with solid materials; then the mating edges of the top are sealed. The seal along the bottom is especially critical—not only to avoid having the contents leak from the container but also to assure that the bottom is more or less flat and thus can stably support the container in an upright position.

Materials have been proposed for constructing these containers totally from plastics to avoid the need for a separate plastic sealant on the exterior of the container, to obtain more consistently good seals on bottoms, and to improve impact resistance and strength. However, several problems have hampered such development, among which are: (1) producing seals on the bottoms of the containers of adequate strength and impact resistance, as well as of low silhouette, to stably support the container in its normal upright position. Where sealing operations are performed at remote processing plants manned by field personnel inexperienced in the properties and characteristics of plastics material, seals inadequate in these aspects are especially prevalent; (2) reducing the high production cost of plastics containers due in part to the amount of plastics material required to strengthen the container to withstand the pressure needed to pick up the container without a handle either to dispense its contents or place it in a suitable enclosure, such as a refrigerator; and (3) developing a plastic container adapted for use with automatic scoring, erecting and filling machines presently in the field representing a substantial capital investment on the part of the field processor.

It has been proposed to overcome several of these problems by forming a blank of plastics material identical with the paperboard blank. The blank would then be erected into a container and its bottom sealed at a centralized location. The completed container would then be shipped to some other location for filling. All forming steps at the centralized location may thus be accomplished by personnel properly trained in handling plastics. However, the cost of shipping empty containers to the filling location is substantial, and potential buyers have been reluctant to use this type of container in view of its high processing costs.

Briefly, in accordance with one aspect of the present invention, a low-cost cotnainer blank of plastics material is preferably formed and erected to a materials-enclosing container by the steps of: (1) forming by extruding or blow-molding a tubular blank preform member having at least a side wall, an open end and a closed arcuate end edge opposite to said open end. The closed arcuate edge is formed at the termination of the side wall at the initial stage of formation while the plastics material is in a workable state; (2) cooling to harden the blank preform member; (3) flattening the cooled preform member by urging opposed portions of the side wall toward each other by oppositely directed pivoting movements about the closed arcuate edge of the member; (4) permanently retaining the urged side wall portions in a flattened condition by forming first and second vertical foldlines through the length of the preform. Each foldline has ends intersecting the ends of the closed arcuate edge; (5) scoring the outer broad faces of the preform with a plurality of foldlines to form a flat container blank. The foldline pattern preferably divides the blank into top, side

and bottom panels; and (6) selectively folding the panels to form a fluid-tight container having a seamless bottom construction. In forming the container of the present invention, the side walls are formed by applying uniformly controlled pressure inwardly toward the geometric center along the vertical retainer foldlines. Controllable pressure is also applied along the first arcuate edge at the bottom of the blank to form the bottom panels into a reentrantly oriented central bottom member terminating at its ends in double-ply bottom tuck-up panels. The tuck-up panels are rotatable about the plane of attachment to the side panels for controlled attachment within the reentrant cavity of the central member.

Among the advantages of the resulting container blank and container are: (1) a low-silhouetted container blank convenient for stacking and storing at a centralized location and for transporting to any remote processing location; (2) a fluid-tight container in which critical sealing of the bottom is completed at the manufacturing site; and (3) a stable fluid-tight container in which the reentrant bottom provides an inner surface on which the compressive forces of the materials can be exerted without outwardly deforming below its plane of contact with a support surface.

Additional features and advantages of the present invention will become apparent from the following specification and accompanying drawings, in which:

FIGURE 1 is an elevational view of a process line for forming, in sequence, the blank preform members and the container blanks of the present invention;

FIGURES 2, 3 and 4 illustrate a preferred embodiment of the preform blank members of the present invention;

FIGURES 5 and 6 illustrate a prefererd embodiment of a processed preform blank of the present invention;

FIGURES 7, 8 and 9 illustrate a preferred form of the container blank of the present invention;

FIGURE 10 is a front elevation of the completed container;

FIGURE 11 is a section of FIGURE 10 taken along line **11—11**;

FIGURES 12, 13 and 14 illustrate the formation of the container of FIGURE 11;

FIGURE 15 is a section taken along line **15—15** of FIGURE 14;

FIGURE 16 is a side elevation of a machine for forming the container of FIGURE 11;

FIGURE 17 is a side elevation of the container blank of the present invention;

FIGURES 18, 19 and 20 schematically illustrate the operation of the machine of FIGURE 16;

FIGURES 21 and 22 are alternative views of the bottoms of the completed container, with FIGURE 22 illustrating an alternative score pattern; and

FIGURES 23 and 24 are front and rear elevational views, slightly enlarged, of the container blank of FIGURES 7 and 8.

Referring now to the figures, particularly FIGURE 1, it is seen that an extruder **10** includes a hopper **11** of pelletized plastics material and the necessary equipment for heating the plastics material to a soft, workable state for forming an array of blank preform members **12**. The extruder **10** is seen to be aligned with other process equipment at the right of FIGURE 1, such as cutting and rolling assembly **16**, scoring assembly **17** and stacking and casing assembly **18**, for further forming—in sequential process stages—the blank preform members **12** into stacked container blanks **15** as explained below. It is to be noted that the container blanks **15** are illustrated as the product of a blow molding process; however, an extrusion process could be substituted without departing from the intended scope of the present invention.

To form the array of blank preforms **12**, a molding system **19** is operatively connected to the extruder **10**; and, as indicated, a plurality of molds **20** maintained at the periphery of rotating wheel **21** are sequentially filled with the plastics material after such material has been heated and passed through dual-head dies **23** to provide a soft parison **22**. Preferably the molds are hinged along a side coextensive with the axis of symmetry thereof; each mold half **20***a* thus may pivot into contact with mating stationary mold half **20***b* along axes aligned with each other and with the parison **22**. To close the molds, suitable operators, such as air cylinders **24**, are operated in sequence by means of a central pneumatic registry control system located in the center of the molding system **19**. The molds being closed at a rate controlled in accordance with the other processing steps of the present invention. As previously mentioned, parison **22** is initially formed by dies **23** of extruder **10**; but, as each mold is closed by the air cylinders **24**, the ends of a length of parison are trapped and sealed together within the mold. Simultaneously, a hollow blow needle (not shown) is positioned within the mold and adapted to protrude into and to penetrate the parison. Air is then introduced to expand the parison into contact with the walls of the mold where freezing of the parison occurs. Inasmuch as the process is continuous, the rate of the extrusion of the parison is preferably controlled so that the untrapped portion of the parison exterior of the molds is not severed as the mold closes but forms a continuous web **12***a* between the emerging array of preformed blanks **12**. Water and/or air are also supplied to each mold after the blowing operation is completed, as from rotary distributors on the wheel **21**, for cooling the mold and preformed blanks.

When emerging from the plurality of molds **20**, the array of blank preform members **12** have a characteristic orientation suitable for further processing steps in accordance with the method aspects of the present invention. For example, as shown in FIGURES 2, 3, and 4, each blank preform **12** is a closed-ended cylinder and includes upper and lower fused edges **29** arcuate with respect ot the geometric center of the preform with a continuous side wall formed between these edges. The arcuate edges **29** are formed at the termination of the side wall while the plastics material is in a molten state.

As seen in FIGURE 2, the shape of the side wall varies as a function of distance from the edges **29**. It may have a circular cross section at midpoint plane **28**; but toward the edges **29**, the cross section becomes elliptical. The shape of the outer surface of the side wall is correspondingly affected forming outwardly, but continuously inclined, surfaces **32** (FIGURE 2) and inwardly inclined surfaces **34** (FIGURE 4) which terminate at the arcuate fused edges **29**. Although the cross section of the preforms at midpont plane **28** is shown as circular, other cross sectional shapes can also be used without departing from the intended scope of the present invention. For example, the cross section could be elliptical. Preferably, however, the focal distances of the ellipses defined between the midpoint plane **28** and fused edges **29** increase as a function of distance from plane **28** reaching a maximum at edges **29**. The degree of inclination of the surfaces **32** and **34** relative to the longitudinal axis A of each preform is preferably such that the circumference of the preform, measured along any plane normal to the axis A, remains constant throughout the length of the preform. In this manner, later process steps involving severing each preform along midpoint plane **28** and flattening the subdivided preform by pivoting the side wall about the fused edge **29**, as by operation of cutting and rolling assembly **16**, establishes a container blank of low, flat silhouette suitable for stacking. At the edges **29**, there are also found webs **12***a* to connect adjacent preforms in an end-to-end array.

Cutting and rolling assembly **16** has flattening rollers **24** preceded in operative sequence by a cutter guide mechanism **25** which: (1) severs the web **12***a* and cuts each preform along midpoint plane **28**, as by means of knives; and (2) correctly aligns the subdivided preforms with respect to rollers **24**, as by means of guide **26**.

In the alignment of the preforms, cut edges **27**—i.e., edges of the plane **28** as seen in FIGURE 6—are preferably arranged to follow the arcuate fused edge **29** through rollers **24**. For such alignment, guide **26** selectively rotates those preforms which, at the instant that the preforms are severed along plane **28**, lie to the left of the cutters **25**, as viewed in FIGURE 1. After alignment by guide **26**, the preforms will be oriented so as to pass between the rollers **24** in a horizontal plane of the arcuate edge **29**; and, as the movement continues, opposed segments of the side wall of each preform are urged together (flattened) by the rollers. The direction of movement of the opposed segments is inward toward the geometric center of the preform and is pivotally centered about the arcuate edge **29**.

The processed blanks emerging from cutting and rolling assembly **16** are shown in detail in FIGURES 5 and 6. Each blank includes vertical foldlines **40** and **41** establishing first and second coextensive side panels **42***a* and **42***b*. The shape of lower edge **29** remains arcuate with respect to the geometric center of the preform. It thus includes a positive sloping segment **38** and a negative sloping segment **39**. The length of arcuate edge **29** is thus greater than the horizontal distance extending from the intersection of the end of edge **29** with the foldlines **40** and **41**. The rate of change of these shapes with distance is preferably, but not necessarily, a similar straight-line relationship across the width of the preform. Thus the segments intersect at a common point—apex **43**. Along the upper cutting edges **27** of the article, the side panels are seen to be free to open (see FIGURE 6) as to receive processing tools in later process steps in the fabrication of the container. When formed in the manner just described, the processed blank preforms have a low silhouette and are easily stacked.

Referring again to FIGURE 1, longitudinally spaced from the flattening rollers **24** are first and second main printing rollers **44** mated with back-up rollers **45**. The printing unit includes inking mechanism **46** transversely movable relative to the printing rollers, as well as a dryer **47** located adjacent to the inker for drying the ink on the surfaces of the processed preforms.

Still referring to FIGURE 1, scoring assembly **17** scores the articles after they have passed through the printing rollers **44**. The scoring assembly **17** basically includes a housing **48** having a base **49** and an input section **50**. The input section **50** indexes the incoming blank preforms with the angular displacement of first and second rotating scoring rollers **51** and **52** paired with back-up rollers **53** and **54**, respectively, and cut-off roller **55** paired with back-up roller **56**. Preferably the first and second scoring rollers **51** and **52** sequentially score sides of the articles **13** with a series of foldlines to form container blanks **15** shown stacked with crates **57**. These rollers are preferably of large diameter to score several articles at one time. For scoring, sets of dies having scoring rules or knives are mounted on the circumference of the rollers. As rotation occurs, these rules contact the side panels of each article at the correct time. The back-up rollers **53** and **54** contact the articles from a non-scored side to provide a suitable bearing area. Each container blank **15** (FIGURES 7, 8 and 9) is thus provided with side and end panels clearly defined by a suitable pattern of foldlines.

Remaining pairs of rollers **55** and **56** carry similar arrangements of dies but are of increased height to fully cut the scored preforms along the upper cut edges **27**. The scrap material cut by these rollers is immediately withdrawn from the scored preforms. The resulting series of container blanks **15** are thereafter stacked and cased in a convenient fashion as by stacking and casing assembly **18**. Assembly **18** is seen to consist preferably of an input section **58** that gathers the blanks emerging from scoring assembly **17** into a linear array and output section **59** for mechanically and automatically casing the array into the cardboard crates **57**. Each crate contains a predetermined number of container blanks **15** for shipment to a more remote filling plant.

Referring now to FIGURES 7 and 8, the score pattern of the container blanks **15** as cased with crates **57** is illustrated. It is seen that each blank is divided by foldlines into a series of panel areas—a central panel area **70**, a bottom panel area **71** and a top closure panel area **72**—after emerging from scoring assembly **17**. These areas are adapted to form the side walls, bottom wall and top closure of the completed container. The areas are defined by upper cut edges **73**, more centralized horizontal foldlines **74** and **75**, and the lower arcuate edge **29**.

As shown in more detail in FIGURES 23 and 24, the central foldlines **74** and **75** are continuous about the front and back sides of each blank. To provide a completed container of square or rectangular cross section the central area **70** includes vertically extending corner foldlines **76**, **77**, **78** and **79** that intersect the upper edges **73** and the lower arcuate edge **29**. The corner foldlines also intersect the central foldlines **74** and **75**. Each corner foldline is parallel to the side wall foldlines **40** and **41** and intersects the horizontal foldlines **74** and **75** to collectively define front, side and back side panels that match front panels **80**, **81** and **82** with back panels **83**, **84** and **85**. In the vertical direction, each of the side panels is in edge contact with the adjacent side panels. A fluid-tight side closure is thus formed continuous about the interior of the blank.

When the vertical corner foldlines **76**, **77**, **78** and **79** are outwardly folded to form the corners of the container, the side panels are released from contact with one another to form the side walls of the container. As there are six side panels to form four side walls, the two nonadjacent pairs of side panels—i.e., panels **80** and **85** and panels **82** and **83**—are inwardly folded along the foldlines **40** and **41** until each pair is aligned in a common plane to form a single side wall of the container. Remaining side panels **81** and **84** form the remaining side walls of the container. These panels are formed simultaneously with the movement of the side panels **80**, **82**, **83** and **85**.

Bottom panel area **71** is fashioned into the bottom wall of the completed container. It is connected to the lower edges of the side panels along the transverse foldline **75** to define front and back bottom closure panels that match panels **87**, **88** and **89** on the front and panels **90**, **91** and **92** on the back. These panels terminate along arcuate edge **29** in an integral engagement to form a fluid-tight fused seam. The score pattern of the bottom panels differs as indicated in the figures in the following manner; first and second nonadjacent panel pairs comprising panels **87** and **92** and panels **89** and **90** are adapted to engage the panel pairs **88** and **91** along extensions **93**, **94**, **95** and **96** of the vertical corner foldlines **76**, **77**, **78** and **79**. Bottom panel **87** is also seen to be in vertical edge engagement with panel **92** along a lower segment of vertical foldline **41**; similarly, panel **89** has edge engagement with panel **90** along vertical foldline **40**.

At an inclined section of each panel **87**, **89**, **90** and **92** are symmetrically oriented diagonal foldlines **102***a*, **102***b*, **103***a* and **103***b* which extend between horizontal foldline **75** and arcuate edge **29**. Each diagonal foldline has an origin point respectively at the intersection of horizontal foldline **75** with corner foldlines **76**, **77**, **78** and **79**. As indicated, the diagonals of each pair of panels intersect at a common terminating point at the intersection of the vertical foldlines **40** and **41** with arcuate edge **29**.

Although the transverse boundaries of the bottom panels are similar to those of the side panels, the primary fold direction of the bottom panels is upward toward the geometric center of the container blank. To provide mating corners at the intersection of the bottom and side panels, the extensions **93**, **94**, **95** and **96** are flared

slightly toward the foldlines 40 and 41. Preferably, but not necessarily, the extensions are perpendicular to the arcuate lower edge 29. It is along these extensions and diagonals 102*a*, 102*b*, 103*a* and 103*b* that the bottom panels are formed to provide a central transverse bottom wall of the completed container. Although the bottom wall of the present invention is formed of these bottom panels, its final orientation substantially differs. Accordingly, separate numerals are used hereinafter to designate the form of the bottom wall and its elements—as, for example FIGURES 10 and 11 where the bottom wall 97 of the completed container is seen to include a central planar wall 98 and a pair of double-ply tuck-up panels 100 and 101.

The relationship between the bottom wall 97 of the bottom panels of the container blank is best seen by compairing the container of FIGURE 21 with the blank of FIGURES 23 and 24.

It can be seen from the figures, the triangular tuck-up panels 100 and 101 are formed of bottom panels bisected by the lower extensions of the vertical foldlines 40 and 41. Specifically, bottom panels 87 and 92 are formed into tuck-up panel 100 by back-folding both panels along diagonal foldlines 102*a* and 102*b*. Similarly, tuck-up panel 101 is composed of bottom panels 89 and 90 similarly back-folded as along diagonal foldlines 103*a* and 103*b*. Furthermore, the tuck-up panels 100 and 101 are integrally connected to the side panels 80, 82, 83 and 85 along opposed segments of the horizontal foldline 75. The tuck-up panels also connect at their respective ends to the central wall 98—integrally along the aligned pairs of extension foldlines 93 and 96 and 94 and 95, respectively, as well as separately along their vertices 104 by an adhesive.

On the other hand, the central wall 98 has only a single ply construction composed of bottom panels 88 and 91 coplanarly aligned. These panels connect along arcuate edge 29 to each other; connect to the side panels 81 and 84 along the central segments of foldline 75; and connect to tuck-up panels 100 and 101 along pairs of aligned extensions 93 and 96 and 94 and 95, respectively.

To provide curvature over the central region, the central wall is longer along arcuate edge 29 than along central portions of foldline 75 connecting it with the side panels 81 and 84. Initially, the curvature is concave with respect to the geometric center of the container as illustrated in FIGURES 12, 13, 14 and 15. These figures show the blank during its formation at the instant in time after pressure has been applied along vertical foldlines 40 and 41 to cause inward movement of panels 80, 82, 83 and 85 to form pairs of side walls. Thereafter the curvature is reshaped to a convex orientation relative to the geometric center by passing the wall 98 through the plane defined by horizontal foldline 75 to form the container of FIGURES 10 and 11. Among the advantages of the formed reentrant bottom wall are better load-carrying capacity and increased container stability.

A modification of the score pattern of the bottom panels is shown in FIGURE 22 where these panels are provided with downwardly directed, but inwardly converging, foldlines 105*a*, 105*b*, 106*a* and 106*b* across their central region. These converging foldlines originate from the intersection points of the horizontal foldline 75′ with the vertical foldlines forming the corners of the side panels. They terminate at a common point—the apex 43′ of the arcuate edge 29′—to form triangular panels 107, 108, 109, 110, 111 and 112. The resulting triangular panels are selectively folded along the converging foldlines 105*a*, 105*b*, 106*a* and 106*b* to form the planar central wall 98′ pyramidally concave with respect to the geometric center of the blank. The curvature of wall 98 is thereafter reoriented to a convex pyramidal shape by passing the wall through the plane of foldline 75′. Tuck-up panels 100′ and 101′ are formed of panels scored in a pattern similar to that of the previously described blank and are folded to their triangular shape as the side walls of the container are formed. The formation of this modified container is completed by folding tuck-up panels 100′ and 101′ into engagement with the panel wall 98′. FIGURE 22 illustrates the formation of the modified container at the instant in time when the wall 98′ has been reoriented to a convex contour relative to the geometric center but before the tuck-up panels have been folded into engagement with the central wall 98′.

Referring again to FIGURES 23 and 24, at the top of the blank there are a plurality of panel extensions to give the completed container a characteristic closure. The closure also provides for a dispensing means for the materials within the completed container—as, for example, a gable-shaped, outwardly flexible spout. It should be noted, however, that other score patterns for the upper panel extension could be used—as, for example, flat-top, fold-over gable shapes—without departing from the intended scope of the invention since the top closure, as illustrated, only indicates a convenient and known way of providing a top closure for the container. To provide the characteristic gable shape, as illustrated, these panels may include a horizontal score line 114 generally parallel to and located above the score line 74. Side roof panels 115, 117, 118 and 120 are defined between these horizontal foldlines and are separated from one another by upper extensions of the foldlines 76, 77, 78 and 79. Between these extensions are the end roof panels 116 and 119. Each end roof panel includes triangular fold-back panels 133 and 134 defined by upwardly directed foldlines 135 and 136 intersecting one another at vertex 137 on the horizontal foldline 114. The remaining roof panels are formed in adjacent pairs—i.e., panels 115 and 120 and panels 117 and 118—to form the side roof panels of the closure. Each pair of side roof panels 115, 117, 118 and 120 is formed by applying inward pressure along the foldlines 40 and 41 causing each pair of panels to pivot about such foldlines until aligned in a common plane. The side roof panels 115 and 117 include upwardly directed foldlines 138 terminating at a vertex 139 on the horizontal foldline 114. Above the horizontal score line 114, ribs 140 of the blank are fashioned from the roof panels 115, 116, 117, 118 and 120 and include a series of inner and outer rib panels, as well as sealing panels forming the ridgepiece of the gable of the finished container. It can be seen that the blank is thus transformed into a completed container; inwardly directed pressure applied at the roof end panels 116 and 119 may then be used to effect sealing of the top closure.

As previously mentioned, the blank is preferably scored at one location where skilled personnel are available to perform needed supervision of the plastics process. The scored blanks are then usually shipped to another processing station and transformed into a completed container.

Referring now to FIGURE 16, a multistation stationary forming machine 145 may be provided to erect the container blanks 15 into completed containers. It may include a mandrel assembly 146 on which the blanks are loaded for sequential erection. The mandrel machine rotates by means of an indexing control mechanism (not shown) to various stations about the periphery of the mandrel assembly where various assembly steps occur, including folding of the side and bottom panels of the blanks to form the side walls and bottom of the container and stripping of the formed containers from the mandrel.

Inasmuch as this invention is primarily related to the shape of the bottom closure of the blank, as well as the container, the operating steps of folding the bottom are an integral part of the present invention. For effecting folding of the bottom of the blank into the desired reentrant shape, for example, the mandrel assembly 146 of forming machine 145 may consist of a spider 165 having a plurality of arms 173 rotatable to pass a series of blanks in sequence through the forming operations.

Initially, a blank is located on one of the arms of the spider, say at load station **166**, is rotated from there to a dwell station **167**, then to a fold station **168**, and then to a bonding station **169** where pressure is applied to the bottom to effect sealing of the tuck-up panels **100** and **101** (FIGURE 18) to the outside bottom surface of the container. The assembly may then be indexed through an idler station to stripper station **170** where an air blast strips the container from a mandrel.

In the sequence of these operations, the flattened blanks are fed one at a time from a stacker support **171** to a body-forming mechanism **172** which forms the blanks into a container having substantially rectangular or square cross section and then feeds the formed containers onto one of the plurality of arms or mandrels **173**. Each mandrel has a rectangular or square cross section similar to that of the container or is formed with several outward radiator spokes whose ends define the figure of a desired cross section. The body-forming mechanism **172** first applies inwardly directed pushing pressure along the plane of the side foldlines **40** and **41** of the blank, as shown in FIGURE 17, thereby pushing the side panels inwardly until the side walls of desired cross section are formed. FIGURE 17 schematically illustrates the direction of these pushing forces to form the side walls.

In forming the tuck-up panels **100** and **101**, forming pressure is applied along arcuate edge **29** at points M and N of the blank of FIGURE 17 by a pusher mechanism **175** of the forming machine of FIGURE 16, say at fold station **168**. The bottom panels thus fold upwardly along the diagonal foldlines at the points of pressure application; e.g., as along diagonals **102***a* and **103***a*. The pusher mechanism **175** is controlled by the rotation of the spider to provide downward movement to the tubular container blank onto the mandrel in a direction parallel to the axis of symmetry of the mandrel. Since the blank need not be seamed along its side, only the bottom must be formed to produce a fillable container. The top is sealed in a separate operation.

As schematically illustrated in FIGURE 18, the plane of alignment of the bottom panels forming the tuck-up panels is changed from a position parallel to the side panels to a position normal thereof.

Forming the bottom to be reentrantly displaced relative to the side walls of the container occurs by applying pressure over the bottom wall of the container, as by a breaker shoe operated by air pressure which can be a part of pusher mechanism **175**. As previously noted, the horizontal length of the bottom wall at its center—i.e., along the arcuate edge **29** of the partially completed container of FIGURE 18—is greater than its length along the segments of the foldline connecting the side panels **81** and **84** to the bottom wall. As upward pressure is applied, as at apex **43** as shown in FIGURE 18, the bottom wall pivots and moves upwardly; this movement ceases when the wall is convexly oriented with respect to the geometric center of the container. The tuck-up panels **100** and **101** are then rotated along the direction of arrows **176** and **177** of FIGURE 19 into the cavity formed by the reentrant orientation of the bottom wall of the container by the movement of the same shoe or by a separate tucker on the forming machine of FIGURE 16. The tuck-up panels are then secured, as shown in FIGURE 20, to the outer surfaces of the central bottom wall by a pressure pad **179**. Bonding usually occurs at the bonding station **169** of the forming machine. Thereafter, the container is stripped from the mandrel at stripper station **170** and subsequently admitted to a filling machine where the container is filled and the top is closed by assembly operations not shown.

While the embodiment of the present invention as disclosed constitutes preferred forms, other forms may be apparent to those skilled in the art. In this regard, plastics materials useful in the present invention may include those materials solid at room temperature, such as: aliphatic polyolefins, such as polyethylene and polypropylene; vinyl polymers and copolymers, such as vinyl butyral, vinyl chloride, etc.; and acrylic polymers and copolymers.

We claim:

1. A container in accordance with the present invention formed of plastics material or the like and fashioned from a container blank having a series of foldlines dividing said blank into a series of panel areas, comprising a body member, a top closure engaging an upper edge of said body member, and a seamless bottom wall engaging a lower edge of said body member, said bottom wall comprising a central panel member reentrantly formed with respect to said body member having a pair of first opposed edges in integral engagement with said lower edge of said body member and a pair of second opposed edges transverse to said first edges, and a pair of double-ply tuck-up panels in simultaneous integral edge engagement with said lower edge of said body member and with said first edges of said central panel member.

2. Said container of claim **1** in which said tuck-up panels are foldable along said engaging edges into alignment with said reentrantly formed central panel member.

3. Said container of claim **2** further characterized by means for permanently securing said tuck-up panels to said central panel member at an end remote from said engaging edges.

4. A container of plastics material or the like, fashioned from a container blank having a series of foldlines dividing said blank into a series of panel areas, comprising a body member having four coextensive side panels, each of which integrally engages at least two adjacent side panels along first and second vertical edges, a top closure integrally engaging an upper edge of said body member, and a seamless bottom wall integrally engaging a lower edge of said body member, said bottom wall comprising a reentrantly formed central panel relative to said body member terminating in transverse and longitudinal edges, and a pair of double-ply tuck-up panels in simultaneous integral edge engagement with said transverse edges of said central panel and with said other side panels of said body section, said central panel integrally engaging two of said side panels along said longitudinal edges and having thereacross an arcuate foldline defining a pair of planar panel sections, the length of said panel sections along said arcuate foldline being greater than along said longitudinal edges to provide said reentrant contour.

5. Said container of claim **4** in which each of said tuck-up panels comprises first and second back-folded triangular members having a common vertex and separate first and second base edges remote from said vertex in respective integral engagement with one of said transverse edges of said central panel member and one of said side panels of said body section, said tuck-up panels inwardly foldable along said base edges to engageably connect to said central panel member.

6. Said container of claim **5** in which said first and second triangular members forming each of said tuck-up panels integrally engage each other along opposed side edges between said common vertex and said base edges.

7. A container blank formed of plastics material or the like to provide a fluid-tight lower edge and in which a series of foldlines divides said blank into a series of foldable panel areas to form a flat blank, comprising a plurality of side panels, each of which engages at least two adjacent side panels along first and second vertical foldlines to form a continuous fluid tight side closure, a plurality of top closure panels attachable to said side panels, and a plurality of bottom panels integrally attached to side panels as extensions thereof along a single continuous horizontal foldline intermediately located between the upper and lower edges of said blank, each of said bottom panels having at least one terminating edge in an integral engagement with a terminating edge of another of said bottom panels to form said fluid-tight lower edge of said blank.

8. Said container blank of claim 7 in which said fluid-tight lower edge is verticaly aligned and coplanar with at least two opposed vertical foldlines of said side panels to place opposed broad surfaces of said side, top and bottom panels in a juxtapositional relationship.

9. Said container blank of claim 7 in which said lower edge is arcuate with respect to the geometric center of said blank.

10. Said container blank of claim 7 in which said plurality of bottom panels comprises three pairs of said panels, each of said pairs being composed of first and second planar panels having parallel and coextensive broad surfaces and terminating in integral edge engagement to form said fluid-tight lower edge of said blank.

11. Said container blank of claim 10 in which said first and second panels of two nonadjacent pairs of bottom panels are adapted to engage one another along a first vertical foldline and engage said remaining pairs of bottom panels along second vertical foldlines, said first and second vertical foldlines intersecting both said horizontal foldline and said lower fluid-tight edge of said blank, said first and second panels including symmetrically arranged inclined foldlines intersecting separately said horizontal foldline and each other at the intersections of said first vertical foldlines and said lower fluid-tight edge to form triangularly shaped tuck-up panels when said bottom panels are folded inwardly along said inclined foldlines.

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