March 6, 1956 W. E. AMBERG ET AL 2,737,332

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Fig. 1.

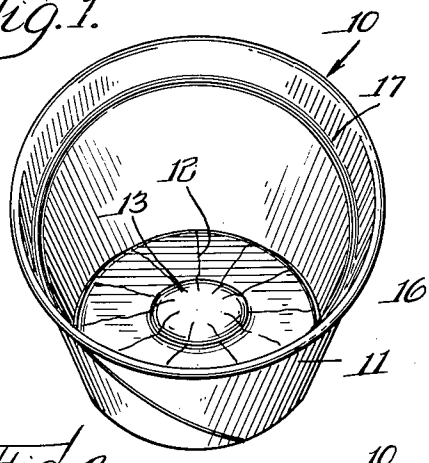


Fig. 2.

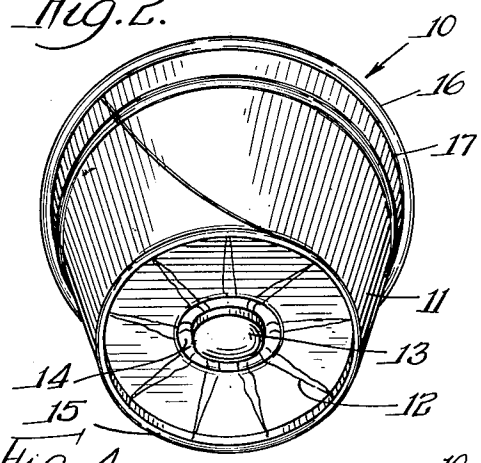


Fig. 3.

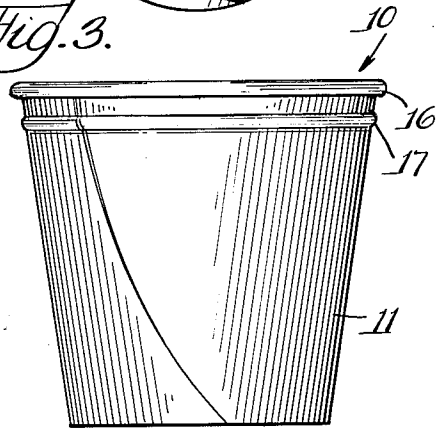
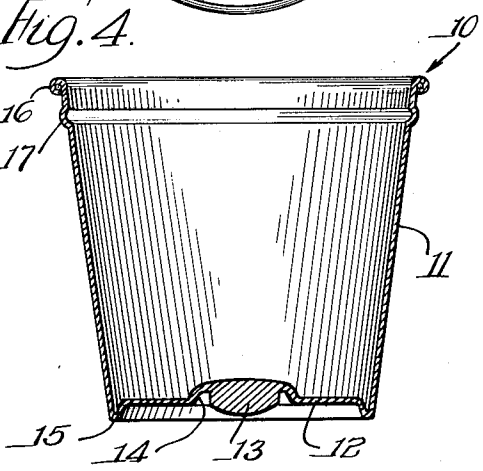


Fig. 4.



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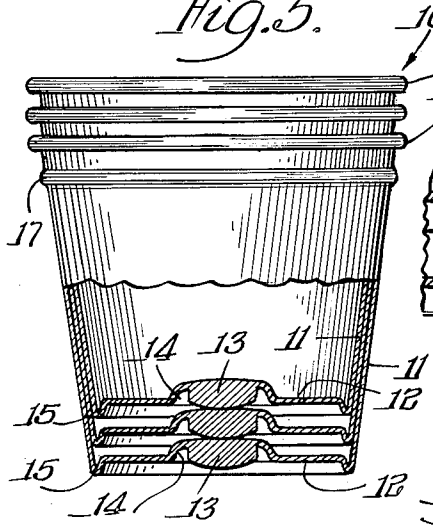

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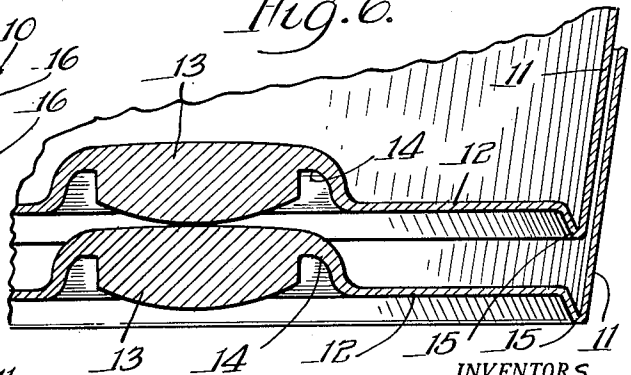

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March 6, 1956 W. E. AMBERG ET AL 2,737,332

ONE-PIECE PAPER CONTAINER

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Fig. 7.

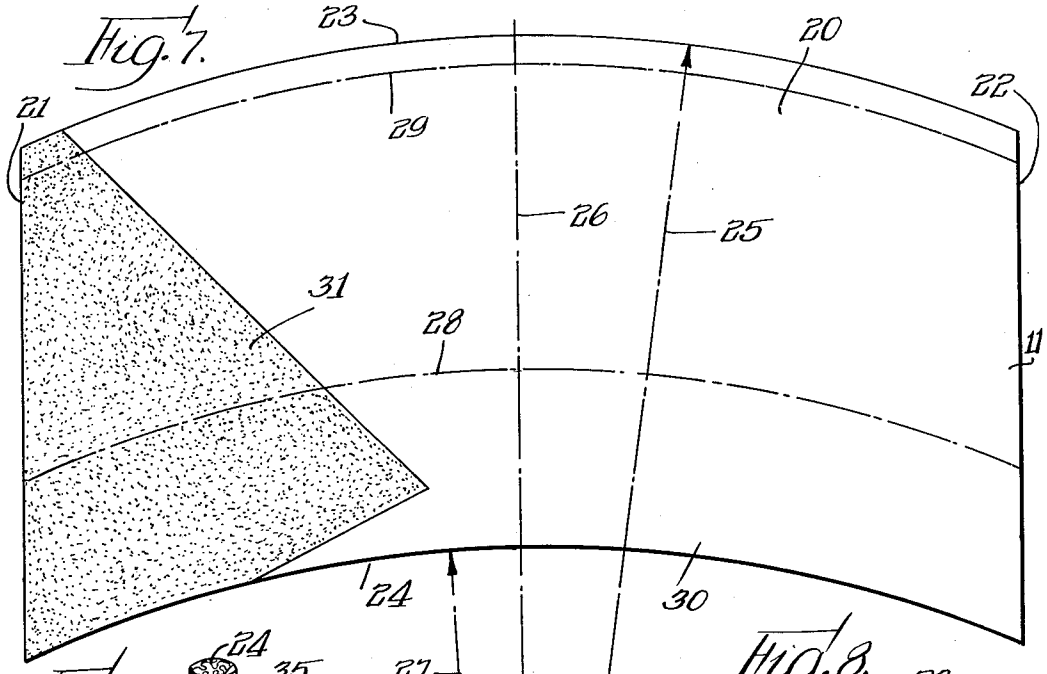
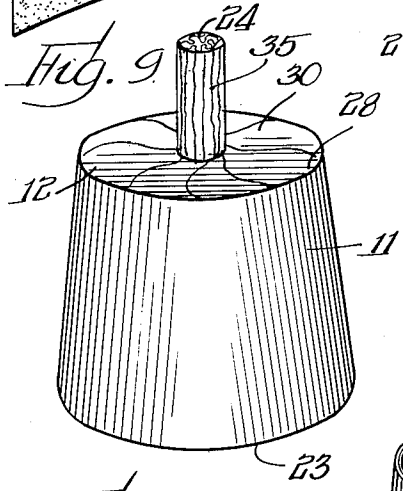


Fig. 9



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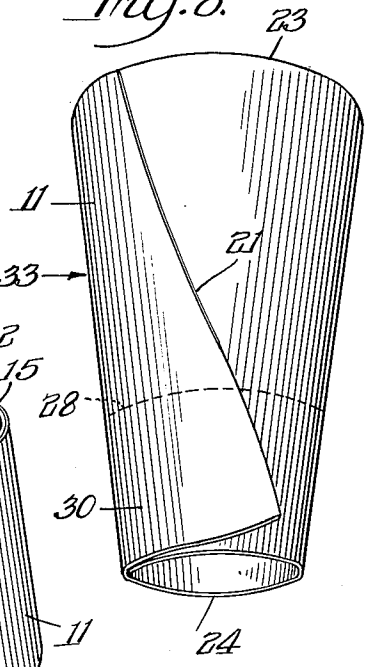

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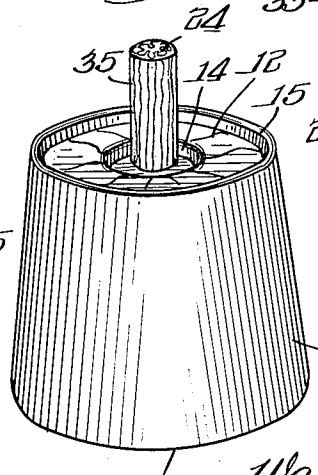
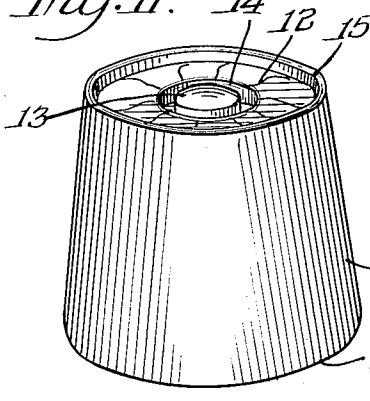


Fig. 11.



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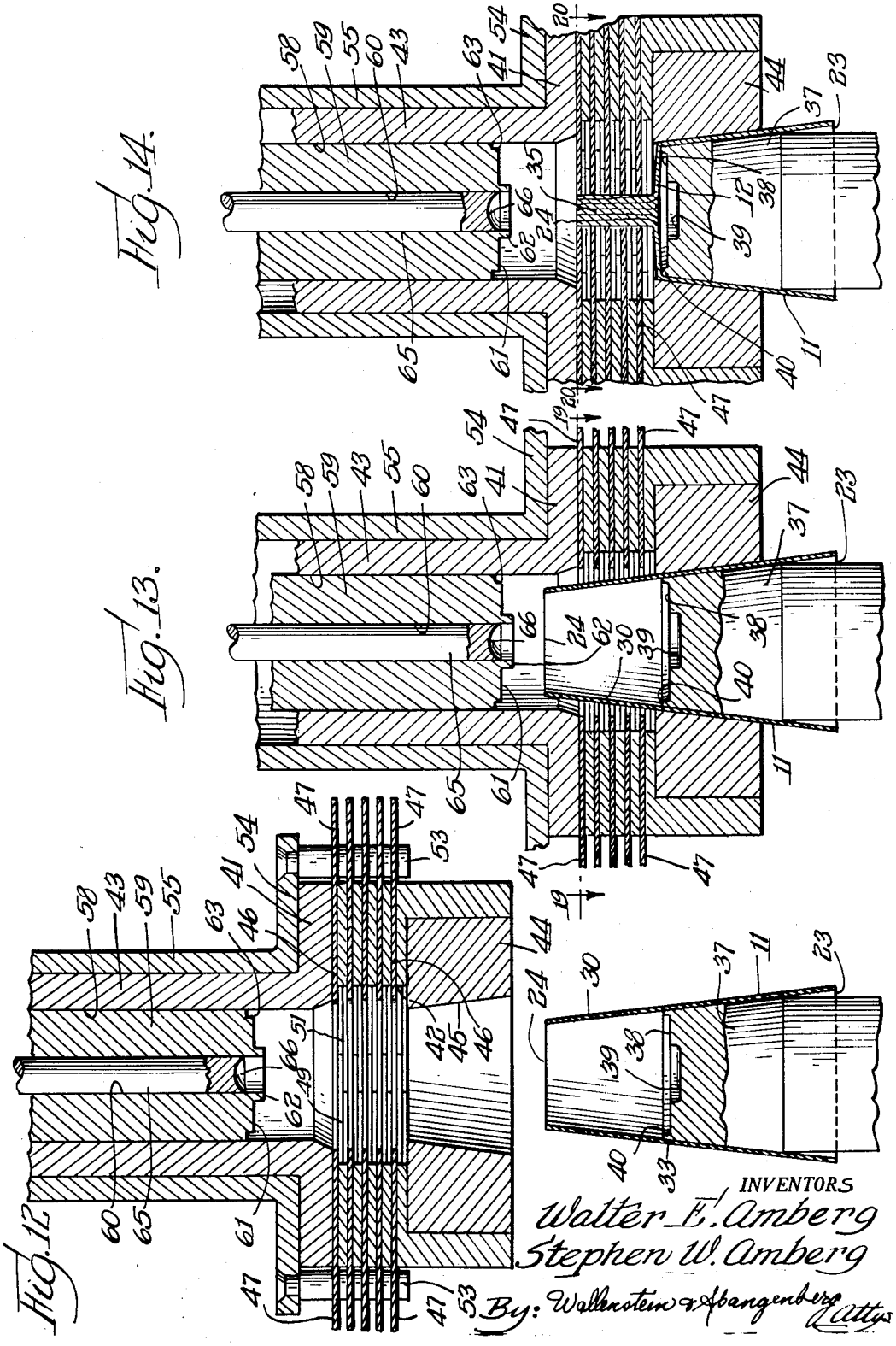

Fig. 14.

Fig. 13.

Fig. 12.

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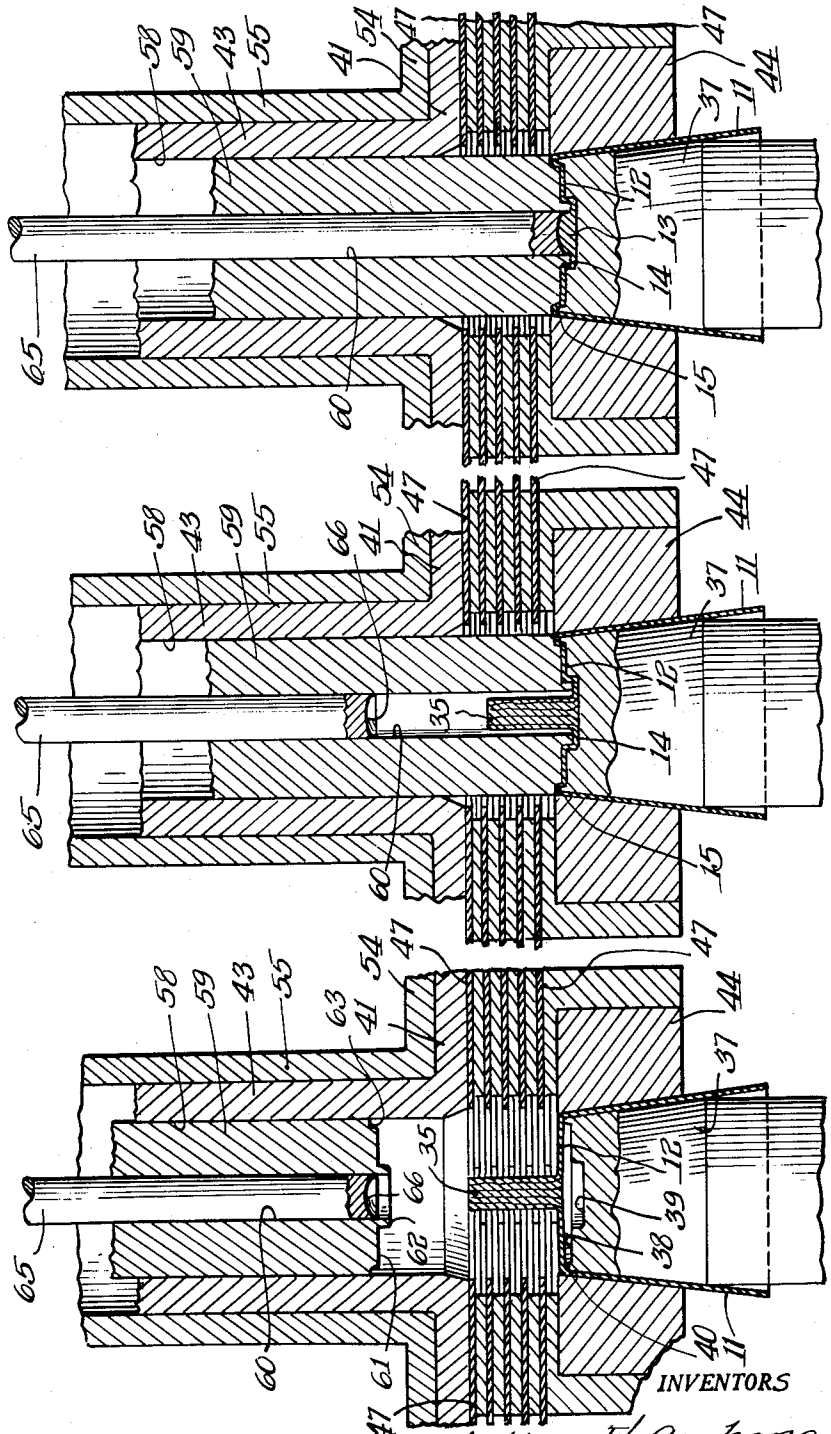

Fig. 17.

Fig. 16.

Fig. 15.

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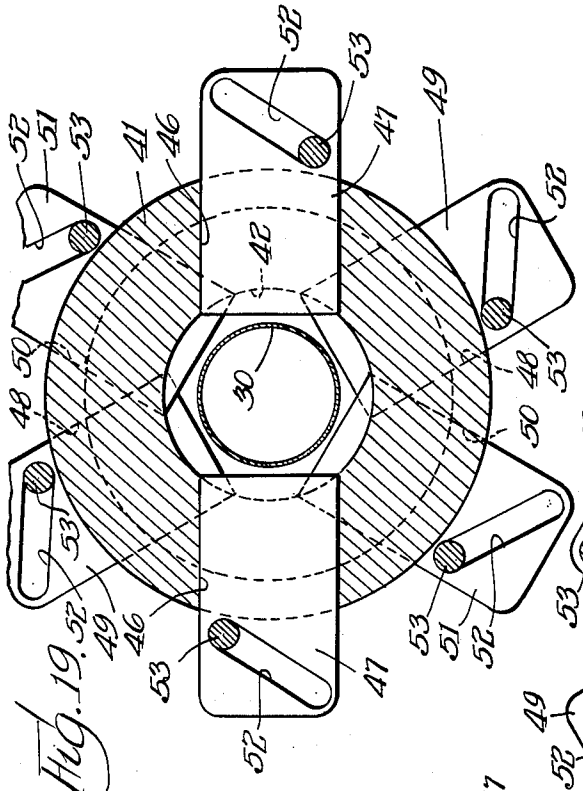


Fig. 19.

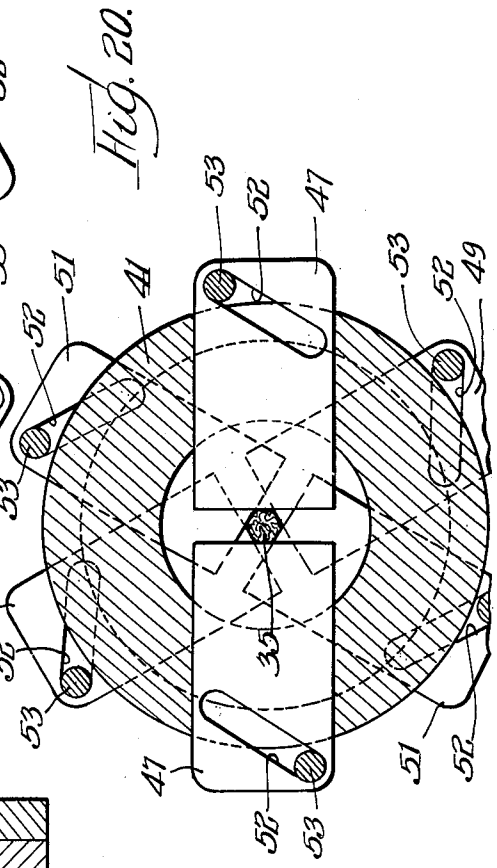
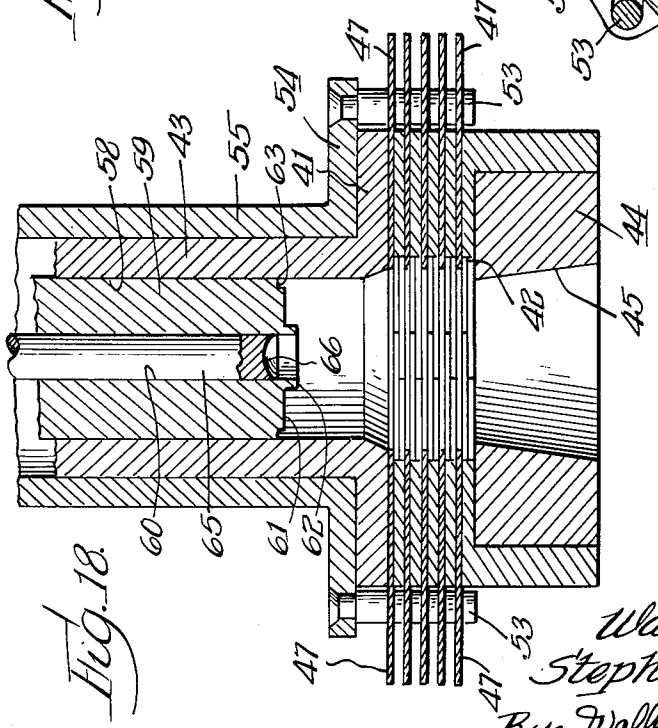


Fig. 20.



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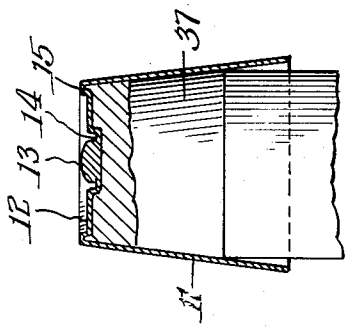

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Fig. 21.

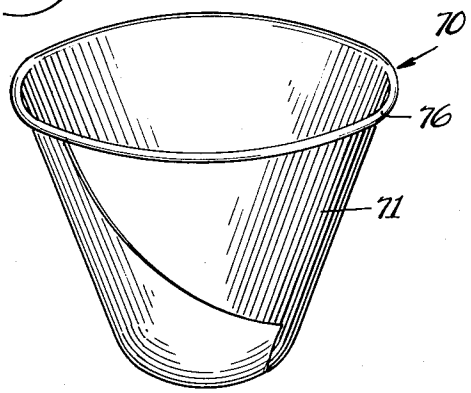


Fig. 22.

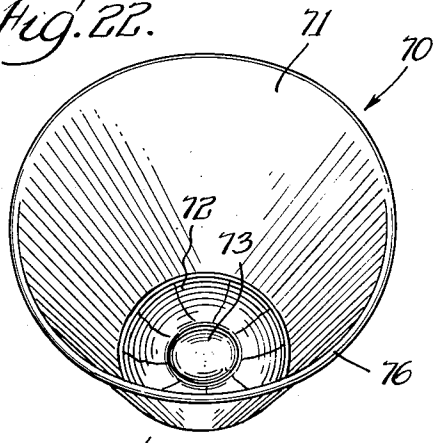


Fig. 24.

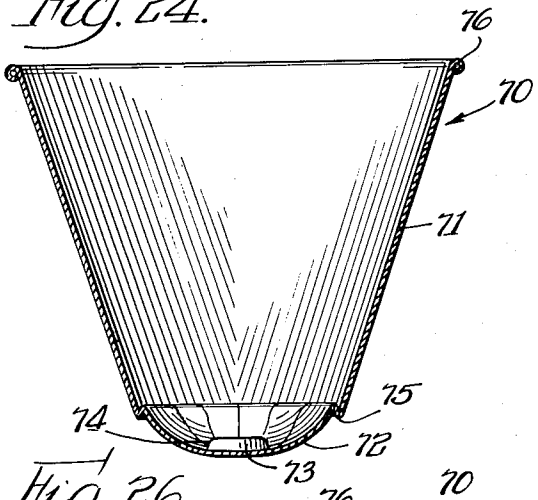
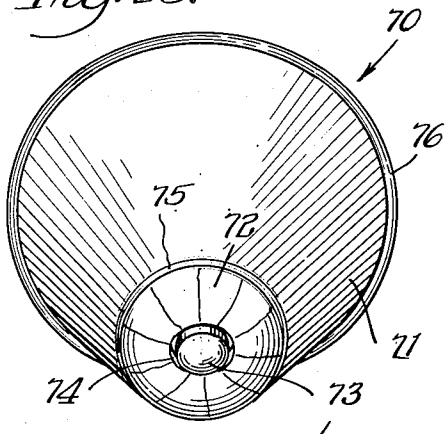


Fig. 23.



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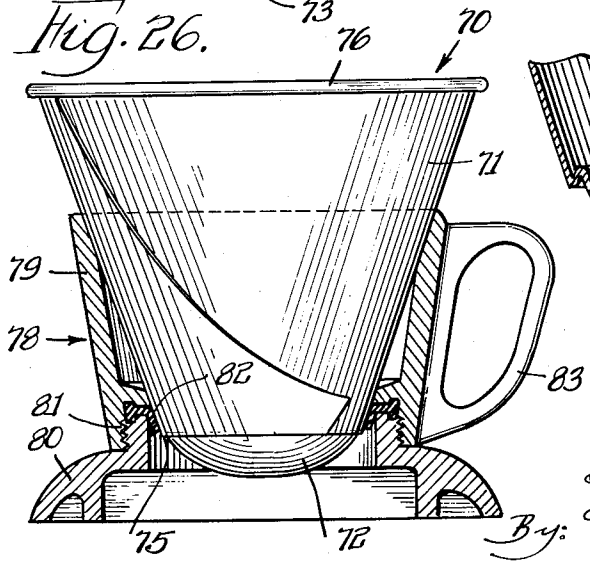
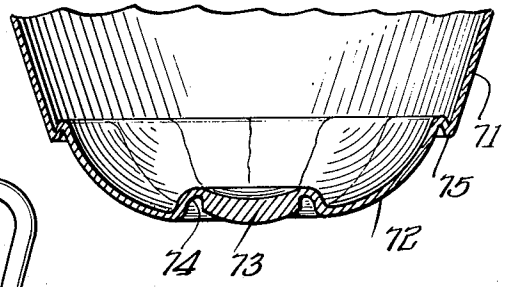


Fig. 25.



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March 6, 1956 W. E. AMBERG ET AL 2,737,332

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Fig. 27.

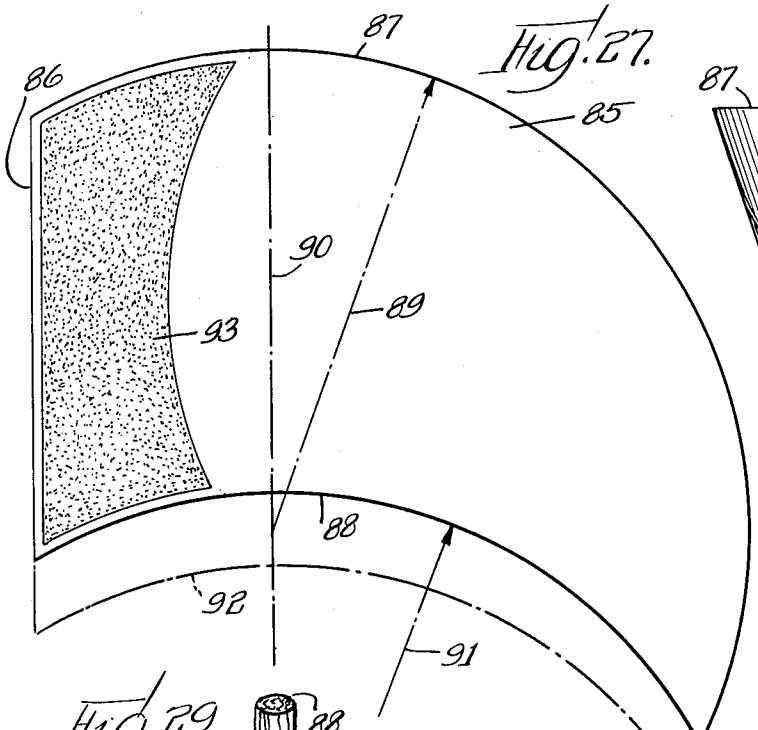
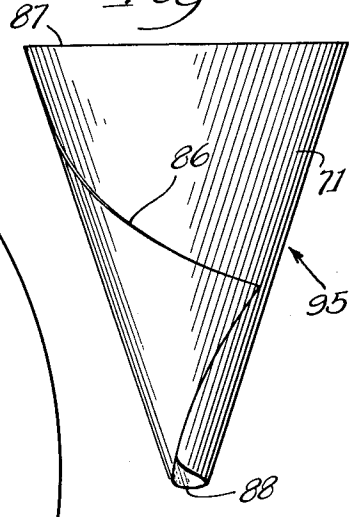


Fig. 28



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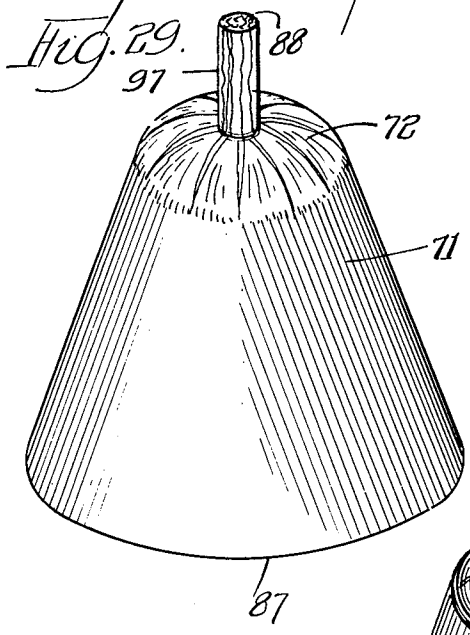

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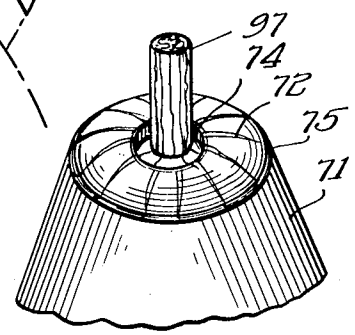

Fig. 31.

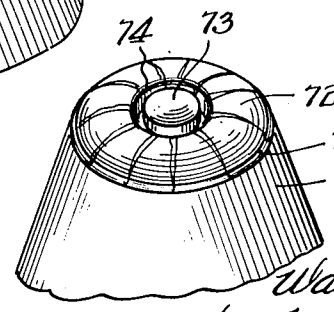

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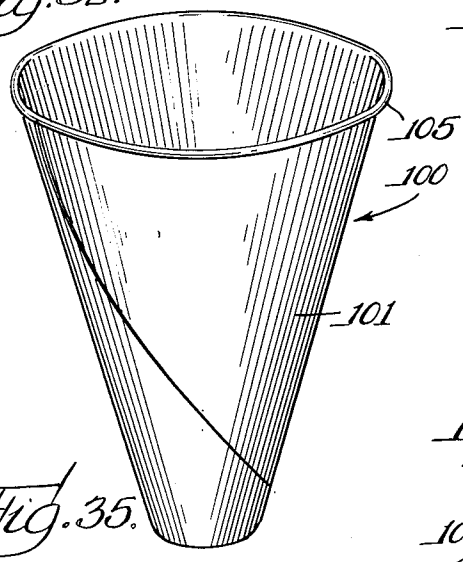
Fig. 32.



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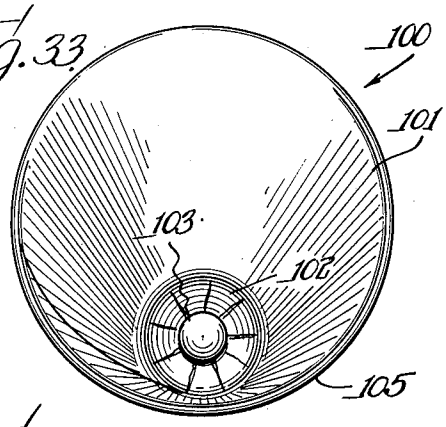

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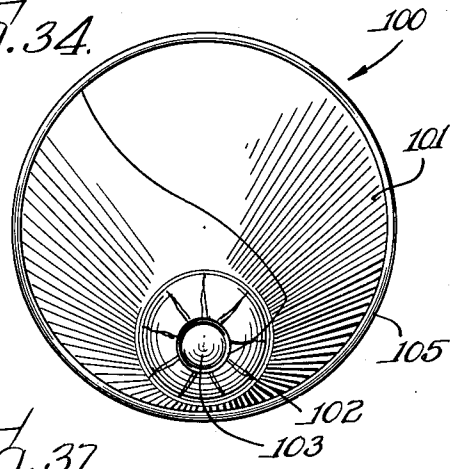

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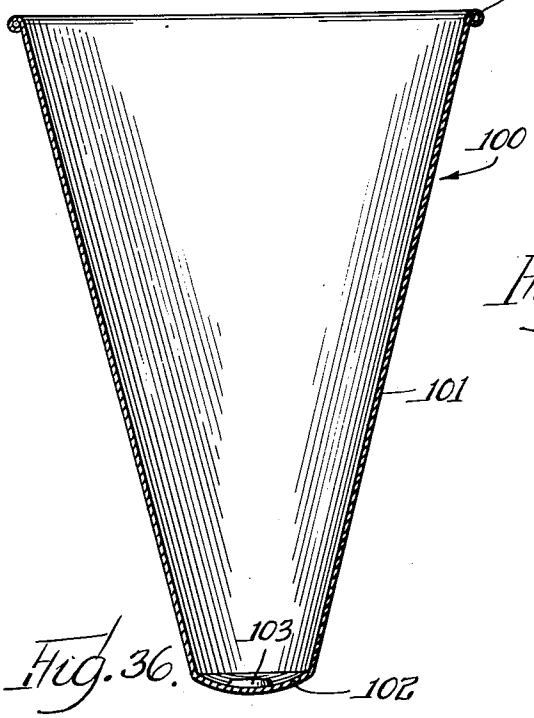

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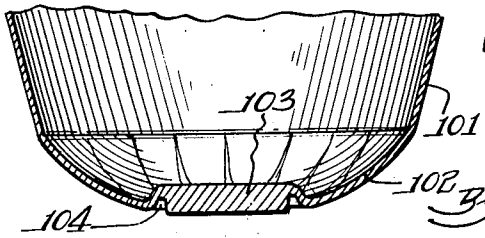
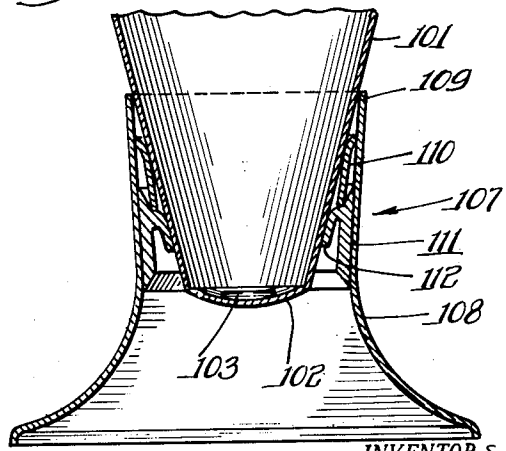


Fig. 37.



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March 6, 1956 W. E. AMBERG ET AL 2,737,332

ONE-PIECE PAPER CONTAINER

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Fig. 38.

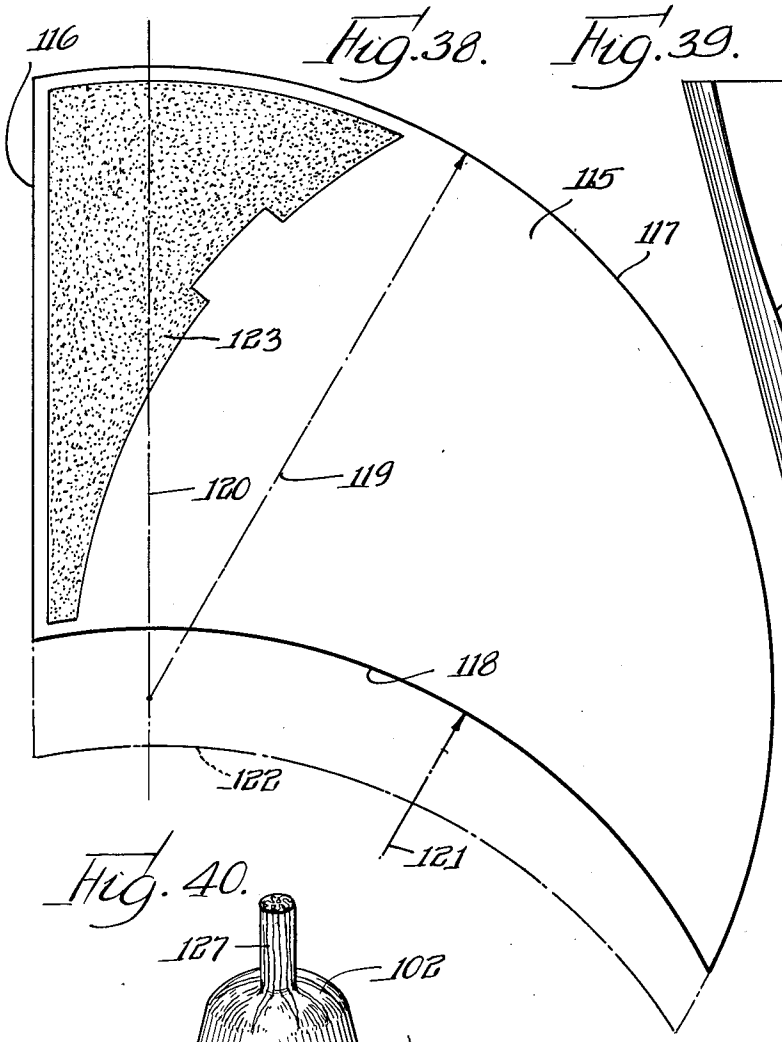


Fig. 39.

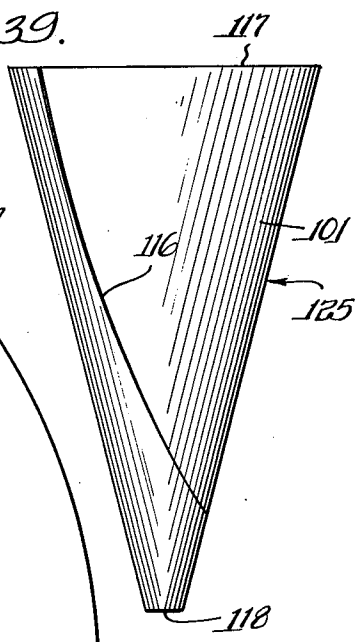


Fig. 42.

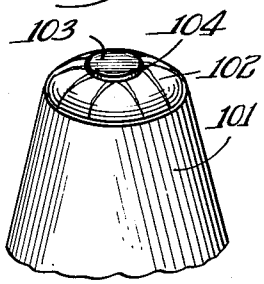


Fig. 40.

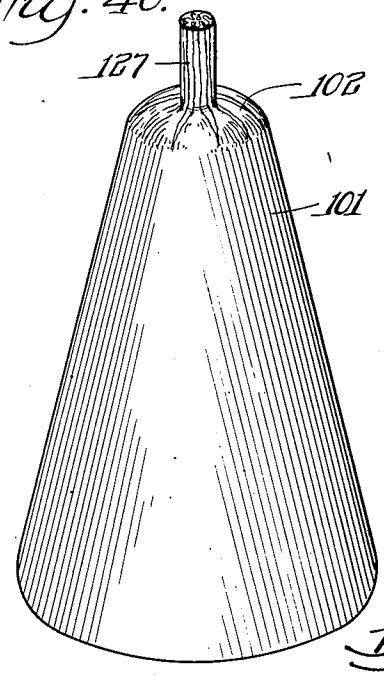
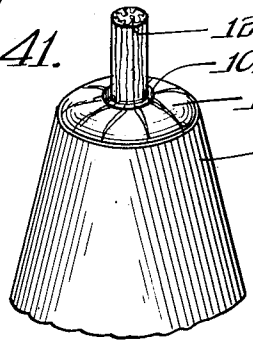


Fig. 41.



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United States Patent Office 2,737,332 Patented Mar. 6, 1956

2,737,332

ONE-PIECE PAPER CONTAINER

Walter E. Amberg, Chicago, and Stephen W. Amberg, Barrington, Ill., assignors to Lily-Tulip Cup Corporation, a corporation of Delaware

Application July 13, 1951, Serial No. 236,571

12 Claims. (Cl. 229—1.5)

This invention relates to one piece paper containers and the method and apparatus for making the same.

An object of this invention is to provide an improved one piece paper container having a side wall, preferably smooth, and a substantially radially pleated transverse bottom wall provided with a central solid paper button. The pleated paper and the central solid paper button of the transverse bottom wall make the same extremely strong and durable. If desired, the central button may be utilized in spacing apart nested containers so that they may be readily removed from a stack of such nested containers. The smooth side wall may be of any desired shape, such as, for example, cylindrical, frusto-conical or the like. Likewise, the pleated transverse bottom wall may also have any desired shape, as for example, to form a substantially flat bottomed paper container or to form a substantially rounded bottom paper container.

The improved one piece paper containers of this invention have a wide variety of uses. For example, they may be used for packaging almost anything, including solids, liquids, foodstuffs and the like, they may be used as self-standing flat bottom containers, tubs, cups and the like, or they may be used as rounded bottom cups or the like to be supported by suitable holders.

Briefly, the one piece paper containers of this invention are formed from a paper side wall open at its top and bottom. The bottom portion of the paper side wall is substantially radially gathered into an outwardly projecting central pillar of closely gathered longitudinal pleats and the paper between the side wall and the central pillar of gathered paper is substantially radially pleated. The radially pleated paper is then compressed into the transverse bottom wall and the central pillar of closely gathered paper is closely confined. The closely confined central pillar of gathered paper is then compressed into a central solid paper button of a transverse dimension substantially the same as that of the pillar, and in so doing the longitudinal pleats of the central pillar are collapsed into overlapping and interlocking transverse pleats.

The open ended side wall, from which the one piece paper container is made, may be of any desired shape, such as cylindrical, frusto-conical or the like, depending upon the desired ultimate shape of the container. The open ended side wall may be formed from a paper blank which may be rolled and secured into the desired side wall shape. For example, in the case of a frusto-conical side wall the paper blank may have a convex curved edge on on side and a concave curved edge on an opposite side, the curved edges having the same radius of curvature so that the blanks may be cut from a paper sheet with minimum waste. The center of curvature of the convex curved edge is located outside of the paper blank beyond the concave curved edge and the convex curved edge forms the larger circular top edge of the frusto-conical side wall. Such a blank, which forms an open ended frusto-conical side wall, saves considerable paper over a blank which would be utilized for forming a complete conical side wall or container.

The substantially radial gathering of the bottom portion of the paper side wall into the central pillar of closely gathered paper and the formation of the substantially radial pleats between the smooth side wall and the central pillar of gathered paper is preferably accomplished by exerting substantially radial pressure against the perimeter of the bottom portion of the paper side wall and progressively reducing its perimeter until the pleating and the central pillar of closely gathered paper are formed. The cross sectional area of this central pillar of closely gathered paper is substantially equal to the cross sectional area of the paper in the side wall which is gathered into the central pillar, the paper being closely gathered at this stage but not crushed or upset. This method of forming the pleats and the central pillar of closely gathered paper is simple to perform, places minimum stress and strain upon the paper and reduces rupturing and tearing of the paper to a minimum.

This method may be inexpensively and rapidly performed on a commercial basis by an apparatus including a male die member for supporting the open ended paper side wall with the bottom portion thereof extending beyond the end of the male die member along with a gathering die having a plurality of radially moveable overlapping plates. The male die member and the gathering die are moved toward each other to position the gathering die adjacent the end of the male die member and about the extending bottom portion of the paper side wall. The plates of the gathering die are then moved radially inwardly to gather the extending bottom portion of the paper side wall into the central pillar of closely gathered paper and to pleat substantially radially the paper between the side wall and the central pillar of gathered paper.

Thereafter the substantially radially pleated paper is compressed into the transverse bottom wall and the central pillar of closely gathered paper is closely confined. The transverse bottom wall may be formed into any desired shape, such as, for example, substantially flat or substantially rounded, it may be provided with an outwardly opening annular recess or offset bend adjacent the central pillar of gathered paper for receiving the button in countersunk relation, it may be provided with an annular rib at the juncture of the side wall and bottom wall, or it may be provided with any other desired cross sectional configuration. The annular recesses and ribs cooperate with the substantially radially pleated paper of the transverse bottom wall to form an extremely strong and durable container. The central annular recess also may operate at least partially to recess the central solid paper button formed from the central pillar of gathered paper and in the case of a substantially flat bottomed container the annular rib may also form an annular surface for supporting the container in an upright position.

The compressing of the pleated paper into the transverse bottom wall is preferably accomplished by confining and compressing the same between a pair of suitable die members, one of the die members having a central opening of a diameter substantially equal to the diameter of the central pillar of gathered paper for accommodating and closely confining the same. The die members are shaped to provide the desired configuration to the transverse bottom wall of the container and including, if desired, recesses and projections for forming the annular recesses and ribs in the bottom wall of the containers. The die members are moved toward each other for confining and compressing the pleated

paper therebetween to form the transverse bottom wall of the container.

While the central pillar of closely gathered paper is closely confined, and preferably while the transverse bottom wall is also confined, the central pillar of closely gathered paper is longitudinally compressed and upset into a solid paper button of a transverse dimension substantially the same as that of the pillar. Compressing and upsetting the central pillar of gathered and longitudinally pleated paper while it is closely confined forms a solid paper button which is substantially uniform throughout, which has overlapping and interlocking transverse pleats and which effectively seals the bottom of the container. If the central pillar of gathered paper were not closely confined during the compressing and upsetting operation, it would tend to topple to one side or the other and to spread, tear or open up with the result that the button would not be uniform throughout, would be deteriorated or rotted in parts by excessive compression, would not be properly compressed and upset in other parts and would undoubtedly leak in use. By confining the pleated paper of the transverse bottom wall while the central pillar of gathered paper is being compressed and upset into the central solid paper button, shifting and possible resulting tearing of the pleated paper during the compressing and upsetting operation is entirely eliminated.

This method of forming the transverse bottom wall and the central solid paper button may also be inexpensively and rapidly performed on a commercial basis by an apparatus including a first die member having a central opening of a diameter substantially equal to the diameter of the central pillar of gathered paper for receiving and circumferentially closely confining the same and having a face for engaging the side of the pleated paper having the pillar projecting therefrom, and a second die member having a face for engaging the other side of the pleated paper. Means are provided for moving the die members toward each other for clamping the pleated paper therebetween and compressing the same into the transverse bottom wall. A plunger is slidable in the opening in the first die member and means are provided for moving the plunger toward the second die member, while the pleated paper is clamped between the die members, longitudinally to compress and upset the central pillar of closely gathered paper into the solid paper button of a diameter substantially the same as the diameter of the pillar. The face of the first die member may have an annular projection about its opening and the face of the second die member may have a central recess for forming the central annular recess about the central solid paper button. Likewise, the face of the first die member may have an annular recess at its periphery and the second die member may have an annular projection at its periphery for forming the annular rib at the juncture of the bottom wall and the side wall of the container. These annular recesses and projections on the die members also act firmly to hold the pleated paper of the transverse bottom wall while the central solid paper button is being formed.

Other objects of this invention reside in the details of construction and in the configurations of the improved paper containers of this invention and also in the shape or configuration of the paper blanks utilized in forming the paper containers of this invention.

A further object of this invention resides in the method of forming the paper containers of this invention including the method of forming a side wall into a paper form having a central pillar of closely gathered paper and substantially radial pleats between the side wall and the central pillar, and also in the method of forming such a paper form into a one piece paper container having a side wall and a transverse bottom wall merging with the side wall and including substantially radial pleats terminating in a central solid paper button.

Another object of this invention resides in the apparatus for forming the paper containers of this invention including the apparatus for forming a side wall into a paper form having a central pillar of closely gathered paper and substantially radial pleats between the side wall and the central pillar, and also in the apparatus for forming such a paper form into a one piece paper container having a side wall and a transverse bottom wall merging with the side wall and including substantial radial pleats terminating in a central solid paper button. Separate apparatuses may be used for making in stages the one piece paper containers of this invention or a single apparatus may be used for making the same in a single stage.

Other objects and advantages of this invention will become apparent to those skilled in the art upon reference to the accompanying specification, claims and drawings, in which:

Figs. 1 to 4 illustrate one form of the one piece paper container of this invention; for example, a substantially flat bottom nestable container, such as a self-standing tub, cup, or the like, Fig. 1 being a top perspective view, Fig. 2 a bottom perspective view, Fig. 3 a side elevational view and Fig. 4 a vertical sectional view of the container;

Fig. 5 is a side elevational view partly in section of a plurality of the containers of Fig. 1 nested in a stack;

Fig. 6 is an enlarged partial sectional view illustrating the manner in which the paper containers of Fig. 1 are held separated when in a nested stack;

Fig. 7 is a plan view of a paper blank from which the one piece paper container of Fig. 1 is formed;

Figs. 8 to 11 are perspective views illustrating the manner in which the paper blank of Fig. 7 is formed into the one piece paper container of Fig. 1, Fig. 8 illustrating the formation of the open ended side wall from the paper blank of Fig. 7, Fig. 9 illustrating the formation of the central pillar of closely gathered paper and the partial formation of the bottom wall from the open ended side wall of Fig. 8, Fig. 10 illustrating the completed formation of the transverse pleated bottom including the central annular recess and outer annular rib and Fig. 11 illustrating the manner of forming the central solid button from the central pillar of closely gathered paper;

Figs. 12 to 20 illustrate an apparatus for forming the one piece paper container of Fig. 1 from a side wall having open ends, Figs. 12 to 18 being vertical sectional views through the apparatus in various positions of operation and Figs. 19 and 20 being horizontal sectional views taken substantially along the lines 19—19 and 20—20 of Figs. 13 and 14, respectively. Fig. 12 illustrates the apparatus at the beginning of the forming operation. Figs. 13 and 19 illustrate the position of the apparatus just prior to the formation of the central pillar of closely gathered paper. Figs. 14, 20 and 15 illustrate the positions of the apparatus, respectively, at and after the formation of the central pillar of closely gathered paper. Fig. 16 illustrates the position of the apparatus for completing the formation of the transverse bottom wall. Fig. 17 illustrates the position of the apparatus for forming the central solid paper button. Fig. 18 illustrates the position of the apparatus at the conclusion of the forming operation;

Figs. 21 to 24 illustrate another form of the one piece paper container of this invention, for example, a relatively wide angled paper cup having a relatively large substantially rounded transverse bottom for use with a suitable holder. Such a one piece paper container is particularly adaptable for use as a coffee cup or the like. Fig. 21 is a side perspective view, Fig. 22 a top perspective view, Fig. 23 a bottom perspective view and Fig. 24 a vertical sectional view through the one piece paper container;

Fig. 25 is an enlarged sectional view through the bottom of the one piece paper container of Figs. 21 to 23;

Fig. 26 is a vertical sectional view illustrating the manner in which the one piece paper container of Figs. 21 to 24 is supported by a suitable holder;

Fig. 27 is a plan view of a paper blank which is used in the formation of the one piece paper container of Figs. 21 to 24;

Figs. 28 to 31 are views illustrating the manner of forming the paper blank of Fig. 27 into the paper container of Figs. 21 to 24, Fig. 28 illustrating the open ended side wall formed from the blank of Fig. 27, Fig. 29 illustrating the manner of forming the central pillar of closely gathered paper, Fig. 30 illustrating the manner of forming the transverse bottom wall and Fig. 31 illustrating the manner of forming the central solid paper button;

Figs. 32 to 35 illustrate still another form of the one piece paper container of this invention, for example, a relatively narrow angled container having a relatively small substantially rounded transverse bottom wall, particularly adaptable for use as a cup in which drinks may be mixed and served. This paper container is adapted to be supported by a suitable holder. Fig. 32 is a side perspective view, Fig. 33 a top perspective view, Fig. 34 a bottom perspective view and Fig. 35 an enlarged vertical sectional view of this one piece paper container;

Fig. 36 is an enlarged perspective view of the transverse bottom wall of the one piece paper container illustrated in Figs. 32 to 35;

Fig. 37 is a perspective view illustrating the manner in which the one piece paper container of Figs. 32 to 35 may be supported in a suitable holder;

Fig. 38 is a plan view of a paper blank utilized in the formation of the one piece paper container of Figs. 32 to 35; and

Figs. 39 to 42 are views illustrating the manner in which the paper blank of Fig. 38 is formed into the paper container of Figs. 32 to 35, Fig. 39 illustrating the open ended side wall formed from the paper blank of Fig. 38, Fig. 40 illustrating the manner of formation of the central pillar of closely gathered paper, Fig. 41 illustrating the manner of forming the transverse bottom wall and Fig. 42 illustrating the manner of forming the central solid paper button.

One form of the one piece paper container of this invention is generally designated at **10** in Figs. 1 to 6. It is a substantially flat bottom nestable type paper container having a smooth frusto-conical paper side wall **11** merging with a pleated transverse bottom wall **12**. The pleats in the bottom wall **12** are substantially radially arranged and terminate inwardly in a central solid paper button **13**. An outwardly opening annular recess or channel or reversible bend **14** is arranged about the central solid paper button **13** so that at least a portion of the solid paper button **13** is located within the annular recess **14** in countersunk position. The juncture of the smooth paper side wall **11** and the pleated bottom wall **12**, that is where these two walls merge together, is provided with an annular rib **15**. The substantially radial pleats in the bottom wall **12** reinforce the bottom wall and form an extremely strong and durable container and the annular recess or channel **14** and the annular rib **15** also cooperate with these substantially radial pleats toward this end. The annular rib **15** also forms an annular surface or ridge for supporting the container **10** in an upright position. The top or mouth of the container **10** is provided with a suitable rim **16** formed by rolling the upper edge of the side wall **11** for the purpose of finishing and adding rigidity to the top of the container. The side wall **11** may also be provided with an annular groove **17** for receiving a suitable lid, not shown, for closing the container and maintaining the contents therein.

The one piece paper container **10** has a wide variety of uses, for example, it may be used for packaging almost anything, including solids, liquids, foodstuffs and the like. It is a self-standing or self-supporting substantially flat bottom container and may be made in various sizes for use as tubs, cups and like containers. The paper container **10**, herein specifically illustrated, has a frusto-conical side wall **11** so that a plurality of such paper containers may be nested one within the other, as illustrated in Fig. 5. In this respect the central solid paper button **13** of each paper container is of such a thickness that the side walls **11** of the nested containers are spaced slightly apart whereby the paper container may be readily removed from a stack of such nested containers. In this connection, Figs. 5 and 6 illustrate the manner in which these one piece paper containers are nested in this fashion.

The paper container **10** of Figs. 1 to 6 may be formed from a paper blank **20**, as illustrated in Fig. 7. The paper blank **20** has a pair of straight parallel edges **21** and **22**, a convex curved edge **23** and a concave curved edge **24**, the radii of curvature of the curved edges **23** and **24** being the same. The radius of curvature of the convex curved edge **23** is designated by the broken line **25** and the center of the radius of curvature is located on an extension of the center line indicated in broken lines at **26**. The center of the curvature of the convex curved edge is located outside of the paper blank **20** and beyond the concave curved edge **24**. The radius of curvature of the concave curved edge **24** is indicated by the broken line **27** and here also the center of the radius of curvature is located on an extension of the center line **26**. Thus the paper blank **20** is symmetrical about its center line **26** and a plurality of such paper blanks **20** may be cut from a strip of paper having side edges **21** and **22** without any waste. The convex curved edge **23** of the paper blank **20** forms the larger circular top edge of the one piece paper container **10** and at least a portion of the concave curved edge **24** forms the bottom edge of a side wall when the blank is formed into an open ended frusto-conical side wall. The portion of the paper blank **20** between the dotted lines **28** and **29** forms the side wall **11** of the pleated paper container **10** and the lower portion **30** of the paper blank **20** is formed into the pleated bottom and the central solid paper button of the completed paper container **10**. The extreme top portion of the paper blank **20** between the convex edge **23** and the dotted line **29** is utilized in the formation of the rolled rim **16** in the ultimate paper container **10**. The paper blank **20** is provided with a glue pattern **31** so that when the paper blank **20** is formed into an open ended frusto-conical side wall, generally designated at **33** in Fig. 8, it is maintained in that condition. As will be seen in Fig. 8, the convex edge **23** forms the larger top edge of the open ended frusto-conical paper side wall **33** and at least a portion of the concave curved edge **24** forms the smaller bottom edge thereof. The lower portion of the frusto-conical paper side wall **33** is designated also at **30** in Fig. 8.

Referring now to Figs. 8 and 9, the bottom portion **30** of the paper side wall **33** is substantially radially gathered into an outwardly projecting central pillar **35** of closely gathered and longitudinally pleated paper, and the paper between the central pillar **35** and the side wall **11** is substantially radially pleated by this gathering operation. This gathering of the bottom portion **30** of the side wall is preferably accomplished by exerting substantially radial pressure against the perimeter of the bottom portion **30** of the paper side wall and progressively reducing its perimeter until the pleating and the central pillar **35** of closely gathered paper are formed, as illustrated in Fig. 9. It will be noted that the bottom edge **24** of the frusto-conical side wall **33** appears at the end of the central pillar **35** of closely gathered paper, the paper in the central pillar being substantially longitudinally folded and creased, but not crushed or upset. This pillar **35** of closely gathered paper has a cross-sectional area substantially the same as the cross-sectional area of the paper in the lower portion **30** of the open ended side wall **33**.

Referring now to Figs. 9 and 10, the radially pleated paper between the smooth side wall **11** and the central pillar **35** of closely gathered paper is then compressed into the bottom wall **12** and in this operation the bottom wall **12** is also provided with the outwardly opening central annular recess or channel or reverse bend **14** and the outer annular rib **15**. This formation of the bottom wall **12**, the annular recess **14** and the annular rib **15** may be

accomplished by confining the substantially radially pleated paper and compressing the same between suitable die members.

In forming the central solid paper button **13**, as illustrated in Fig. 11, the central pillar **35** of closely gathered paper, as illustrated in Fig. 10, is first circumferentially closely confined and then the central pillar **35** is longitudinally compressed and upset into the solid central paper button **13** which has a transverse dimension substantially the same as that of the pillar **35**. By closely confining the central pillar **35** of gathered paper while it is being longitudinally compressed and upset, it forms a solid paper button **13** which is substantially uniform throughout, which has overlapping and interlocking transverse pleats and which effectively seals the bottom of the container **10**. If the central pillar of gathered paper were not closely confined during the compressing and upsetting operation it would tend to topple to one side or the other and to spread, tear or open up with the result that the paper button would not be uniform throughout, would be deteriorated or rotted in parts by excessive compression, would not be properly compressed and upset in other parts and would undoubtedly leak in use. Also, it is preferable to confine the pleated paper of the transverse bottom wall **12** while the central pillar **35** of gathered paper is being compressed and upset into the central solid paper button **13**. This prevents shifting and possible resulting tearing of the pleated paper during the compressing and upsetting operation. The central pillar **35** of gathered paper may be closely confined by enclosing the same in a die member opening having a diameter substantially the same as the diameter of the central pillar **35**. The diameter of the opening in the die member should be as close as possible to the diameter of the central pillar **35** for maximum control of the paper therein during the compressing and upsetting operation, but yet be large enough freely to receive the central pillar **35** and allow for possible production variations in the pillar diameter. As a specific illustrative example, a central pillar **35** of gathered paper having a designed diameter of one-quarter of an inch may be readily received in a die opening having a diameter of five-sixteenths of an inch. This permits ready reception of the central pillar in the die opening, closely confines and provides fine control of the gathered paper during the compressing and upsetting operation and produces a uniform central solid paper button having a diameter of five-sixteenths of an inch, substantially the same as the diameter of the pillar. For best results the diameter of the central pillar should not be less than seventy-five per cent of the diameter of the die opening and still more advantageously eighty or eighty-five percent.

After the transverse bottom wall of the paper container **10** is formed, as illustrated in Fig. 11, then the upper part of the smooth paper side wall **11** may be provided with the rim **16** and the annular groove **17** in the conventional manner.

Briefly, therefore, the method of forming the one piece paper container **10**, as illustrated in Figs. 7 to 11, consists in forming a paper side wall **33** opened at its top and bottom, substantially radially gathering the bottom portion **30** of the paper side wall into an outwardly projecting central pillar **35** of closely gathered and longitudinally pleated paper and substantially radially pleating the paper between the side wall **11** and the central pillar **35** of gathered paper, compressing the substantially radially pleated paper into the transverse bottom wall **12**, annular recess **14** and annular rib **15**, circumferentially closely confining the central pillar **35** of gathered paper, and longitudinally compressing and upsetting the closely confined central pillar **35** of gathered paper into the central solid paper button **13** having overlapping and interlocking transverse pleats and having a transverse dimension substantially the same as that of the pillar **35**.

This method of forming the one piece paper container may be inexpensively and rapidly performed on a commercial basis by a suitable apparatus, for example, the apparatus illustrated in Figs. 12 to 20. This apparatus includes a male die member **37** having a frusto-conical surface for receiving and supporting the side wall **11** of the open ended paper side wall **33** with the lower portion **30** of the paper side wall extending beyond the face **38** of the die member **37**, as illustrated in Fig. 12. The face **38** may be provided with a central recess **39** and an annular peripheral projection **40**. A female die member **41** having a cylindrical extension **43** is provided with a gripping member **44** having an annular frusto-conical surface **45** which is adapted to engage the side wall portion **11** of the frusto-conical side wall **33** to hold the male die member **37**. The cylindrical extension **43** of the female die member **41** is suitably operated to form means to move the female die member **41** toward the male die member **37** from the position shown in Fig. 12 to the position shown in Fig. 13 whereby the frusto-conical side wall **33** is securely held in place on the male die member **37**.

The female die member **41** is also a gathering die and, as illustrated more particularly in Figs. 12, 18, 19 and 20, is provided with a plurality of radially disposed slots. Two sets of opposite slots **46** receive a plurality of radially slidable plates **47**, these slots **46** extending through the die member **41** from the outer edge thereof to a central opening **42** therein. A second set of oppositely disposed slots **48** slidably receive a plurality of plates **49**, these slots being offset from the slots **46** and being angularly disposed with respect to the slots **46**. Likewise, other oppositely disposed sets of slots **50** slidably receive a plurality of radially slidable plates **51**, these slots **50** being offset from the slots **46** and **48** and being angularly disposed with respect to those slots. The outer ends of the plates **47**, **49** and **51** are each provided with an angularly arranged slot **52** which in turn receive pins **53** carried by a flange **54** of a rotatable actuating member **55** suitably operated through a limited rotative movement. The actuating member **55** in its limited rotative movement forms operating means simultaneously to move the plates **47**, **49** and **51** radially inwardly and outwardly in their respective slots in the gathering die **41**. When the pins **53** are in the position illustrated in Fig. 19 the plates **47**, **49** and **51** are retracted and when the pins **53** are revolved to the position illustrated in Fig. 20 the plates **47**, **49** and **51** are radially moved inwardly. These radially movable plates **47**, **49** and **51** of the gathering die operate when moved inwardly substantially radially to gather the bottom portion **30** of the paper side wall into the central pillar **35** of closely gathered and longitudinally pleated paper and substantially radially to pleat the paper between the side wall portion **11** and the central pillar **35** of gathered paper, as is illustrated in more detail in Figs. 13 to 15, 19 and 20.

The cylindrical extension **43** of the female die member **41** is provided with a cylindrical opening **58** for slidably receiving a die member **59** which in turn has a central opening **60** which opening is of substantially the same diameter as the central pillar **35** of closely gathered paper. The die member **59** is provided with a face **61**, a central annular projection **62** about the opening **60** and an annular peripheral recess **39** and the annular projection **40** of the die member **37**. The die member **59** has a suitable extension, not shown, forming means for slidably operating the same in the cylindrical extension **43**.

After the central piller **35** of closely gathered paper is formed by the radial die and the radial fingers have been retracted, as illustrated in Fig. 15, the die member **59** is then moved toward the die member **37**, as illustrated in Fig. 16. The faces **38** and **61** of the die members **37** and **59** confine and compress the pleated paper into the bottom wall **12** of the paper container, the central recess **39** and the central annular projection **62** of the die members form the annular recess or reverse bend **14** in the pleated paper bottom wall **12** and the annular projection **40** and the

annular recess 63 of the die members form the annular rib 15 at the juncture of the smooth side wall 11 and the pleated bottom wall 12 of the paper container. At the same time the opening 60 in the die member 59 circumferentially closely confines the central pillar 35 of closely gathered paper, as is illustrated in Fig. 16.

A plunger 65 is slidably received in the opening 60 in the die member 59 and it is provided with a face 66. An extension, not shown, on the plunger 65 forms means for advancing and retracting the same. When the plunger 65 is advanced, as illustrated in Fig. 17, the closely confined central pillar 35 of gathered and longitudinally pleated paper is longitudinally compressed and upset between the face 66 of the plunger and the face 39 of the die member 37 into the central solid paper button 13 having overlapping and interlocking transverse pleats. While the central solid paper button 13 is thus being formed, the die members 37 and 59 are clamping the transverse bottom wall of the paper container to prevent sliding and possible rupture of the paper therein. The die members 37, 41 and 59, the plates 47, 49 and 51 and the plunger 65 are all operated in timed relation by a suitable power driven mechanism.

The sequence of operation of the apparatus is shown in Figs. 12 to 18. In Fig. 12 the frusto-conical paper side wall is placed upon the die member 37, then the die member 41 is moved toward the die member 37, as illustrated in Fig. 13, to secure the paper side wall in place therebetween with the lower portion 30 of the paper side wall extending beyond the die member 37. The plates 47, 49 and 51 are then moved radially inwardly, as illustrated in Fig. 14, to form the central pillar 35 of closely gathered paper and radially to pleat the paper between the central pillar 35 and the smooth side wall 11. Thereafter the plates 47, 49 and 51 are retracted, as illustrated in Fig. 15, and then the die member 59 is advanced toward the die member 37, as illustrated in Fig. 16, to form the bottom wall 12, the annular recess 14 and the annular rib 15 and also closely to confine the central pillar 35 of gathered paper. Then the plunger 65 is advanced longitudinally to compress and upset the central pillar 35 of gathered paper into the central solid paper button 13, as illustrated in Fig. 17. The transverse bottom wall, including the solid paper button, is thereby formed and then the die members are retracted to the position illustrated in Fig. 18 for removal of the completed one piece paper container and to place the apparatus in condition for another cycle of operation.

While one apparatus has been illustrated for performing all of the operations upon the open ended side wall or body, of course, these operations may be performed in stages by separate apparatuses, for example, one apparatus not including the die member 59 and plunger 65 may be utilized for forming the central pillar 35 of gathered paper and another apparatus not including the radial die may be utilized for compressing the transverse bottom wall 12 and for forming the central solid paper button 13 from the central pillar 35 of gathered paper. While the apparatus has been illustrated in Figs. 12 to 20 for forming the particular paper container 10 illustrated in Figs. 1 to 4, this same apparatus with minor modifications may be utilized for forming paper containers of other sizes and configurations, as for example, the paper containers generally designated at 70 in Figs. 21 to 25 and at 100 in Figs. 32 to 36.

The one piece paper container generally designated at 70 in Figs. 21 to 24 is a nestable type container particularly adaptable for use as a coffee cup or the like. It has a relatively wide angled smooth frusto-conical side wall 71 and a substantially rounded transverse pleated bottom wall 72 of relatively large diameter. The pleated bottom wall is provided with a central solid paper button 73 and may be provided with an annular recess 74 and an annular rib 75. The upper edge of the paper container 70 may be provided with a suitable rim 76. Thus it is seen that the paper container 70 is very much like the paper container 10 except as to specific configuration or shape.

This paper container 70, having a substantially rounded transverse bottom wall, may be supported by a suitable holder generally designated at 78. This holder may include a receptacle portion 79 secured to a base portion 80 as by means of screw threads 81. Located in the holder adjacent the juncture of the receptacle and base portions 79 and 80 is a resilient washer 82 having fingers to grip the side wall 71 of the paper container or cup 70 for automatically lifting a cup 70 from a stack of nested cups and for maintaining the cup within the holder.

The substantially rounded bottom wall of the cup or container 70 being pleated and provided with the solid paper button 73, the annular recess 74 and the annular rib 75 is extremely strong and durable and holds its shape when the cup is filled with coffee or the like. The substantially rounded bottom provides for efficient mixing of the contents within the cup and because of the construction of the rounded bottom, is not distorted or ruptured in the event that the bottom is forcibly contacted by a spoon or the like.

The method of making the paper container or cup 70 of Figs. 21 to 25 is substantially the same as that described above in connection with the paper container 10. Being of a different configuration, the paper blank for making the paper container 70 is preferably different from the paper blank for making the paper container 10. Fig. 27 illustrates the paper blank from which the paper container 70 is formed. Here the paper blank 85 is provided with a straight side edge 86, a convex curved edge 87 and a concave curved edge 88, the radii of curvature of the curved edges being the same and the centers of curvature being struck from an extension of the center line designated at 90. The radius of curvature of the convex curved edge 87 is indicated by the broken line 89 and the radius of curvature of the concave curved edge is indicated by the broken line 91. The center of the radius of curvature of the convex curved edge 87 lies beyond the concave curved edge 88. The convex curved edge 87 forms the upper edge of the completed paper container. When the paper blank is formed into a frusto-conical side wall, generally designated at 95 in Fig. 28, both ends of the frusto-conical side wall are open, as shown, a part of the concave curved edge 88 of the blank forming the bottom edge of the frusto-conical side wall 95. This is brought about by reason of the fact that the center of curvature of the convex curved edge 87 lies beyond the blank 85. Because the method of forming the transverse bottom wall on the paper container of this invention permits the use of an open ended paper side wall there is a considerable saving in paper afforded over a paper container or side wall which is pointed or closed at its bottom. The amount of paper saved is that amount between the concave curved edge 88 and the curved broken line 92 in Fig. 27. To maintain the frusto-conical paper side wall 95 in place the paper blank 85 is provided with a suitable glue pattern 93.

After the frusto-conical paper side wall 95 is so formed, then the lower portion thereof is substantially radially gathered into an outwardly projecting central pillar 97 of closely gathered and longitudinally pleated paper as shown in Fig. 29, the paper between the smooth side wall 71 and the central pillar 97 being substantially radially pleated.

Then, as illustrated in Fig. 30, the substantially radially pleated paper is compressed into the pleated transverse bottom wall 72, and the outwardly facing annular recess or reverse bend 74 and the annular rib 75 are formed therein. The central pillar 97 of closely gathered and longitudinally pleated paper is then closely confined and is longitudinally compressed and upset into the central

solid paper button 73 having overlapping and interlocking transverse pleats, as illustrated in Fig. 31.

Figs. 32 to 36 illustrate another form of a paper container which is generally designated at 100. This paper container is particularly adaptable for use at soda fountains for mixing and serving drinks. It has a relatively narrow angled frusto-conical side wall 101 and a substantially rounded pleated bottom 102 centrally provided with a solid paper button 103. Here the paper button may also be at least partially received in an annular recess 104. The top of the paper container or cup 100 may be provided with a suitable rim 105.

This paper cup or container 100 may be supported in a suitable holder generally designated at 107 in Fig. 37. The holder includes a base portion 108 and a receptacle portion 109, the receptacle portion being provided with an internal flange 110 for receiving a resilient member 111 having fingers 112. The fingers 112 are adapted to grip the side wall 101 of a paper container 100 for automatically lifting the same from a stack of nested containers and to maintain the container or cup in the holder.

The method of forming the paper container 100 is substantially the same as that described above in connection with containers 10 and 70. However, due to the difference in configuration of the paper container 100 a different shaped paper blank is preferably used. Such a paper blank is designated at 115 in Fig. 38.

The paper blank 115 has a straight edge 116, a convex curved edge 117 and a concave curved edge 118, the radii of curvature 119 and 121 of the two curved edges being the same. The centers of the radii of curvature are located on the center line 120 and the center of curvature of the convex curved edge 117 is located beyond the blank 115. The paper blank 115 is formed into an open ended frusto-conical side wall generally designated at 125 in Fig. 29 and the glue pattern 123 on the paper blank 115 maintains the paper side wall 125 in formed condition. Because this invention forms a transverse bottom from an open ended paper side wall, the amount of paper necessary in making the paper container of this invention is materially less than the amount of paper required to make a conventional conical paper container. This amount of paper saved is the amount between the concave curved edge 118 and the curved dotted line 122 of Fig. 38.

After the frusto-conical open ended side wall 125 is formed the lower portion thereof is substantially radially gathered into an outwardly projecting central pillar 127 of closely gathered paper having longitudinal pleats, as shown in Fig. 40, the paper between the smooth side wall 101 and the central pillar 127 being substantially radially pleated. Then, as illustrated in Fig. 41, the pleated paper is compressed into the transverse bottom wall 102 and may be provided with the outwardly facing annular recess or reverse bend 104. The central pillar 127 of gathered and longitudinally pleated paper is then circumferentially closely confined and longitudinally compressed and upset into the central solid paper button 103 having overlapping and interlocking transverse pleats, as illustrated in Fig. 42.

While for purposes of illustration several forms of this invention have been disclosed, other forms thereof may become apparent to those skilled in the art upon reference to this disclosure and, therefore, this invention is to be limited only by the scope of the appended claims.

What we claim as our invention:

1. The method of making a one piece paper container having a side wall and a transverse bottom wall from a paper side wall open at its top and bottom comprising, substantially radially gathering the bottom portion of the paper side wall by exerting substantially radial pressure about the entire perimeter thereof and progressively decreasing the perimeter thereof into a substantially radially pleated transverse bottom wall and a substantially closed central pillar consisting of closely gathered longitudinal pleats, compressing the substantially radially pleated paper into the transverse bottom wall, circumferentially closely confining the closely gathered longitudinally pleated paper of the substantially closed central pillar, and longitudinally compressing and upsetting the closely confined central pillar into a central solid paper button.

2. The method of making a one piece paper container having a side wall and a transverse bottom wall from a paper side wall open at its top and bottom comprising, substantially radially gathering the bottom portion of the paper side wall by exerting substantially radial pressure about the entire perimeter thereof and progressively decreasing the perimeter thereof into a substantially radially pleated transverse bottom wall and a substantially closed central pillar consisting of closely gathered longitudinal pleats, compressing the substantially radially pleated paper into the transverse bottom wall, circumferentially closely confining the closely gathered longitudinally pleated paper of the substantially closed central pillar, and longitudinally compressing and upsetting the closely gathered longitudinally pleated paper of the closely confined central pillar into a central solid paper button consisting of randomly interlocked paper pleats.

3. The method of making a nestable one piece paper container having a smooth tapered side wall and a transverse bottom wall at its smaller end from a smooth tapered paper side wall open at its top and bottom comprising substantially radially gathering the smaller bottom portion of the smooth tapered paper side wall by exerting substantially radial pressure about the entire perimeter thereof and progressively decreasing the perimeter thereof into a substantially radially pleated transverse bottom wall and a substantially closed central pillar consisting of closely gathered longitudinal pleats, compressing the substantially radially pleated paper into the transverse bottom wall, circumferentially closely confining the closely gathered longitudinally pleated paper of the substantially closed central pillar, and longitudinally compressing and upsetting the closely confined central pillar into a central solid paper button.

4. The method of making a one piece paper container having a side wall and a transverse bottom wall comprising, forming a paper blank into a side wall open at its top and bottom and having an overlapping seam throughout its length, substantially radially gathering the bottom portion of the paper side wall by exerting substantially radial pressure about the entire perimeter thereof and progressively decreasing the perimeter thereof into a substantially radially pleated transverse bottom wall having single and multiple paper thicknesses and a substantially closed central pillar consisting of closely gathered longitudinal pleats, compressing the substantially radially pleated paper into the transverse bottom wall, circumferentially closely confining the closely gathered longitudinally pleated paper of the substantially closed central pillar, and longitudinally compressing and upsetting the closely confined central pillar into a central solid paper button.

5. The method of making a nestable one piece paper container having a smooth frusto-conical side wall and a transverse bottom wall at its smaller end comprising, forming a paper blank having a convex curved edge with its center of curvature beyond the paper blank, forming the paper blank into a smooth frusto-conical side wall open at its top and bottom and with the curved edge of the blank forming the larger top edge of the side wall and having an overlapping seam throughout its length, substantially radially gathering the smaller bottom portion of the frusto-conical paper side wall by exerting substantially radial pressure about the entire perimeter thereof and progressively decreasing the perimeter thereof into a substantially radially pleated transverse bottom wall having single and multiple paper thicknesses and a sub-

stantially closed central pillar consisting of closely gathered longitudinal pleats, compresisng the substantially radially pleated paper into the transverse bottom wall, circumferentially closely confining the closely gathered longitudinally pleated paper of the substantially closed central pillar, and longitudinally compressing and upsetting the closely confined central pillar into a central solid paper button.

6. The method of making a one piece paper container having a side wall and a transverse bottom wall from a paper side wall open at its top and bottom comprising, substantially radially gathering the bottom portion of the paper side wall by exerting substantially radial pressure about the entire perimeter thereof and progressively decreasing the perimeter thereof into a substantially radially pleated transverse bottom wall and a substantially closed central pillar consisting of closely gathered longitudinal pleats, circumferentially closely confining the closely gathered longitudinally pleated paper of the substantially closed central pillar, compressing the substantially radially pleated paper into the transverse bottom wall and forming an annular offset bend in the transverse bottom wall closely adjacent the substantially closed central pillar by tightly confining the same, and longitudinally compressing and upsetting the closely confined central paper pillar, while the substantially radially pleated paper is tightly confined, into a central solid paper button which is at least partially received within the annular offset bend in the transverse bottom wall.

7. The method of making a one piece paper container having a side wall and a transverse bottom wall from a paper side wall open at its top and bottom comprising, substantially radially gathering the bottom portion of the paper side wall by exerting substantially radial pressure about the entire perimeter thereof and progressively decreasing the perimeter thereof into a substantially radially pleated transverse bottom wall and a substantially closed central pillar consisting of closely gathered longitudinal pleats, circumferentially closely confining the closely gathered longitudinally pleated paper of the substantially closed central pillar in a central opening in a die member having an annular projection about the opening, clamping the substantially radially pleated paper between said die member and a second die member having a central annular recess for compressing the same into a transverse bottom wall having an annular offset bend therein closely adjacent the substantially closed central pillar, and longitudinally compressing and upsetting the closely confined central paper pillar by a plunger operating in the opening in the first die member against the second die member, while the substantially radially pleated paper is clamped between the die members, into a central solid paper button which is at least partially received within the annular offset bend in the transverse bottom wall.

8. Apparatus for the manufacture of a one piece paper container having a side wall and a transverse bottom wall from a paper form including an open ended side wall having a bottom portion thereof substantially radially gathered into a substantially radially pleated transverse bottom wall and a substantially closed central pillar of closely gathered longitudinal pleats comprising, a first die member having a central opening of a diameter substantially equal to the diameter of the substantially closed central pillar for receiving and circumferentially closely confining the same and having a face including an annular projection about the opening for engaging the side of the substantially radially pleated paper having the pillar projecting therefrom, a second die member having a face including a central annular recess for engaging the other side of the substantially radially pleated paper, means for moving the die members toward each other for clamping the substantially radially pleated paper therebetween and compressing the same into a transverse bottom wall having an annular offset bend therein closely adjacent the substantially closed central paper pillar, a plunger in the opening of the first die member, and means for moving the plunger toward the second die member, while the substantially radially pleated paper is clamped between the die members, longitudinally to compress and upset the closely confined central paper pillar into a solid paper button which is at least partially received within the annular offset bend in the transverse bottom wall.

9. In the manufacture of a one piece paper container having a side wall and a transverse bottom wall, apparatus for making a paper form from an open ended paper side wall comprising a male die member for supporting the open ended paper side wall with the bottom portion of the side wall extending beyond the end of the male die member, a gathering die having a plurality of circumferentially arranged and radially movable overlapping plates defining a radially expansible and contractible enclosed area between the inner edges thereof, means for moving the male die member and the gathering die toward each other to position the gathering die adjacent the end of the male die member and entirely around the extending bottom portion of the paper side wall, and means for moving the plates of the gathering die radially inwardly to substantially radially gather the extending bottom portion of the paper side wall by exerting substantially radial pressure about the entire perimeter thereof and progressively decreasing the perimeter thereof into a substantially radially pleated transverse bottom and a substantially closed central pillar consisting of closely gathered longitudinal pleats.

10. Apparatus for the manufacture of a one piece paper container having a side wall and a transverse bottom wall from an open ended paper side wall comprising, a first die member for supporting the open ended paper side wall with the bottom portion of the paper side wall extending beyond the end of the die member, a gathering die having a plurality of circumferentially arranged and radially movable overlapping plates defining a radially expansible and contractible enclosed area between the inner edges thereof, means for moving the first die member and the gathering die toward each other to position the gathering die adjacent the end of the first die member and entirely around the extending bottom portion of the paper side wall, means for moving the plates of the gathering die radially inwardly to substantially radially gather the extending bottom portion of the paper side wall by exerting substantially radial pressure about the entire perimeter thereof and progressively decreasing the perimeter thereof into a substantially radially pleated transverse bottom and a substantially closed central pillar consisting of closely gathered longitudinal pleats, a second die member having a central opening of a diameter substantially equal to the diameter of the substantially closed central pillar for receiving and circumferentially closely confining the same and having a face including an annular projection about the opening for engaging the side of the substantially radially pleated paper having the pillar projecting therefrom, said first die member having a face including a central annular recess for engaging the other side of the substantially radially pleated paper, means for moving the die members toward each other for clamping the substantially radially pleated paper therebetween and compressing the same into a transverse bottom wall having an annular offset bend therein closely adjacent the substantially closed central paper pillar, a plunger in the opening of the second die member, and means for moving the plunger toward the first die member, while the substantially radially pleated paper is clamped between the die members, longitudinally to compress and upset the closely confined central paper pillar into a solid paper button which is at least partially received within the annular offset bend in the transverse bottom wall.

11. A one piece paper container comprising a smooth paper side wall open at its top and having its bottom portion substantially radially gathered inwardly into a transverse bottom wall provided with substantially radial pleats

terminating in surplus paper which is closely gathered into a longitudinally pleated outwardly projecting pillar which is longitudinally compressed and upset into a solid tying button having overlapping and interlocking transverse pleats.

12. A one piece paper container comprising a smooth paper side wall open at its top and having its bottom portion substantially radially gathered inwardly into a transverse bottom wall provided with substantially radial pleats terminating in surplus paper which is closely gathered into a longitudinally pleated outwardly projecting pillar which is longitudinally compressed and upset into a solid tying button having overlapping and interlocking transverse pleats, the paper immediately surrounding the button being formed into an outwardly opening annular channel which receives the button in a countersunk position.

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