

Oct. 7, 1969

W. D. WOLF

3,471,075

CONTAINER WALL STRUCTURE

Filed Oct. 20, 1967

2 Sheets-Sheet 1

FIG. I

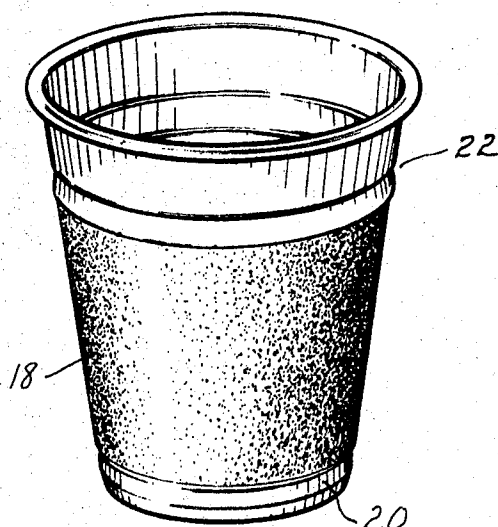
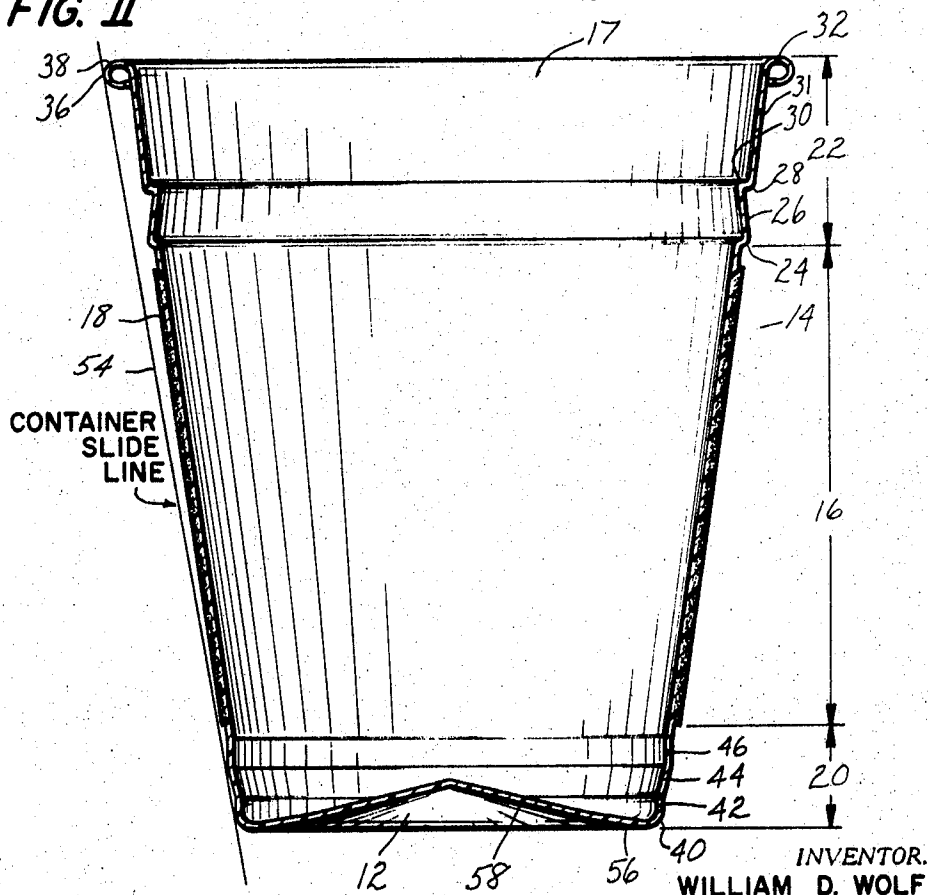


FIG. II



INVENTOR.
WILLIAM D. WOLF
BY
Michael J. Murphy
AGENT:

Oct. 7, 1969

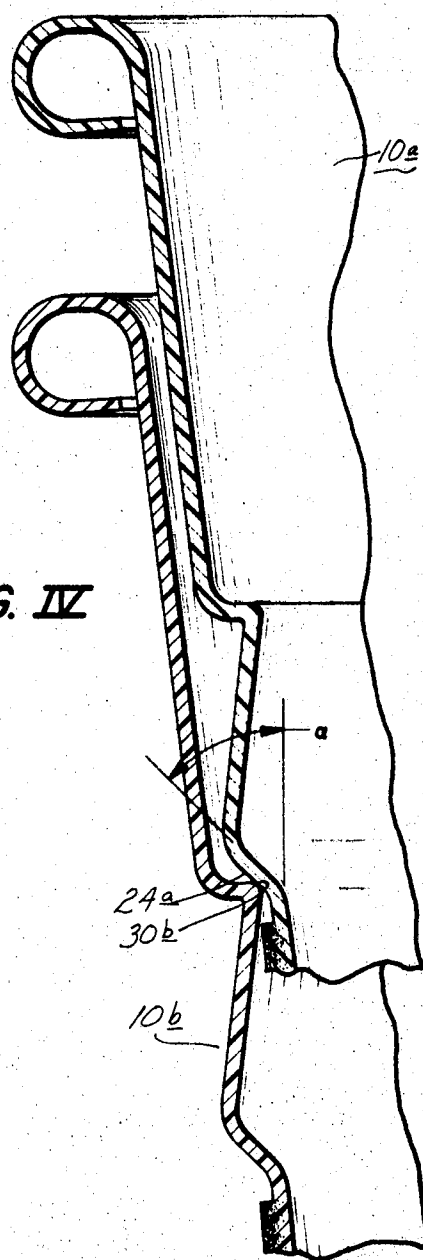
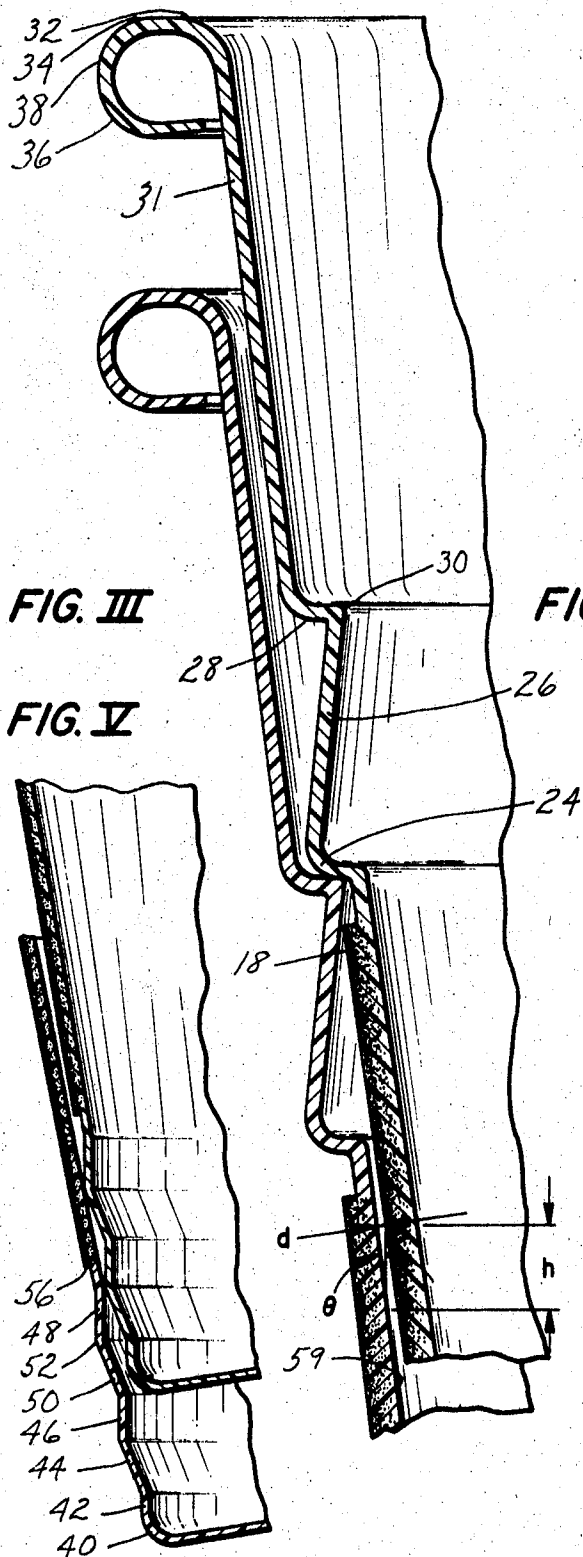
W. D. WOLF

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2 Sheets-Sheet 2



INVENTOR.
WILLIAM D. WOLF

BY

BY: Michael J. Murphy
AGENT:

AGENT:

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3,471,075

CONTAINER WALL STRUCTURE

William D. Wolf, Simsbury, Conn., assignor to Monsanto Company, St. Louis, Mo., a corporation of Delaware
Filed Oct. 20, 1967, Ser. No. 676,929

Int. Cl. B65d 1/00

U.S. Cl. 229—1.5

12 Claims

ABSTRACT OF THE DISCLOSURE

A nestable container for use in automatic dispensing machines, having an improved wall structure for maintaining a clearance between adjacently nested units. The container may have a partially foamed outer surface portion.

This invention relates to containers, and more particularly to nestable containers for use in automatic dispensing machines.

Paper, and occasionally plastic containers have in the past been employed in vending machines for containing such hot beverages as tea, coffee, chocolate, soup, etc. These containers are deficient inasmuch as they have very little heat insulating qualities, and the purchaser usually experiences discomfort in holding the container until the beverage is completely consumed. Consequently, they are being replaced, in certain instances, by the more recently developed plastic type container, which has a foamed insulating surface, as typically described in U.S. Patent No. 3,262,625. Such containers, however, have presented other problems when used in vending machines, inasmuch as the foam has a high coefficient of friction, and therefore a container with such a foamed surface does not consistently feed freely from a nested relationship without jamming.

More specifically, in current vending machine dispensing operations, multiple containers are first carefully stacked, one within another, with their walls spaced by means of stacking provisions on the container body. Care is required in this initial stacking to insure that each nested container is symmetrically spaced within another, since with the current stacking structures it is left to the assembly man to achieve this. The stacks are then inserted in a series of storage turrets vertically mounted in the upper part of the vending machine. These turrets are intermittently rotated when one is emptied, so as to index another full turret above a lower dispensing head. As the assembly rotates the lowermost container in the turret rubs against the surface of a stationary slide plate, located between the dispensing head and the lower end of the turret, and used to keep the stack of containers within a turret from sliding out. The stationary plate has an opening in it through which the stack falls by gravity into the dispensing head aligned below. When the purchaser inserts his coin in the machine, one container is released from the bottom of the stack in the dispensing head, and slides on its side by gravity down an inclined chute into place in the centrally located filling station below. The container is then filled from fill pipes located directly above.

Problems arise during initial stacking if a container stacked within another is not symmetrically seated therein, with the result that its foamed surface contacts an adjoining container surface. Later, when the turrets rotate, the friction of the bottom cup in each stack rubbing against the slide plate causes the whole stack to flex out of axial alignment, so that the foamed surfaces undesirably contact adjacent surfaces of other cups, and then will not consistently release freely from the dispensing head.

Furthermore, the surface of the inclined chute between

the dispensing head and filling station may not be completely smooth, and often becomes coated with hygroscopic materials such as sugar and coffee, if the machine interior is not frequently serviced. These materials build up on the chute surface, and in turn absorb moisture from the hot water vapor within the machine. All of this tends to retard progress of the container down the chute, especially if a foamed portion of the container contacts such an irregular or gummy chute slide surface. The foamed surface, therefore, has been confined previously in length and thickness to limited portions of the container side wall, so as not to interfere with sliding movement of the container along the chute. Naturally, as the extent of foam decreases the insulating effectiveness of the container decreases.

In addition, as is already known, when the lowermost container from a nested stack is released and begins to fall away from its adjoining unit, a slight vacuum is created within the released container due to the sudden increase in free space between the two nested units. This tends to slow the rate at which the containers move away from each other, and incrementally increase the overall container filling cycle of the machine, as well as tending at times to inhibit trouble free denesting.

Any economical container design to overcome the above difficulties is limited by the existing internal configurations of vending machines which accommodate only a limited number of designs. Problems associated with the efficient release of the container from its forming mold must also be kept in mind in any molded container design.

Accordingly, it is a principal object of this invention to provide an improved nestable container.

It is an additional object of this invention to provide an improved nestable container which avoids the many prior art difficulties discussed above.

It is a further object of this invention to provide an improved nestable foamed container for dependable trouble free use in automatic dispensing machines, without requiring modification of existing vending machine designs.

It is an additional object of this invention to provide an improved nestable, partially foamed, molded container which may be conveniently pressure formed and removed from its forming die according to the usual types of molding techniques.

It is a further object of this invention to provide a nestable, partially foamed container having high insulating qualities and a commercially attractive outer appearance.

It is a still further object of this invention to provide a foamed container side wall structure which positively maintains a radial clearance between sidewalls of adjacently nested containers, regardless of the amount of lateral movement of the full container stack.

Other objects of this invention will in part be obvious and will in part appear hereinafter.

These and other objects are accomplished by providing a thin wall nestable container having a base and a sidewall extending upwardly from the base forming an open outer end, the sidewall having a smooth gripping skirt of major extent diverging outwardly of the container axis at a substantially constant angle, the gripping skirt being bounded by a lower undulated section intermediate the base and the gripping skirt, and an upper section intermediate the gripping skirt and the outer end, the upper section having portions offset from the angle of the gripping skirt to define nesting means, the nesting means and undulated section being adapted to cooperate with a like container when one of such containers is supported within another like container to maintain a radial clearance between the sidewalls of the two containers. The container

may have a partially foamed outer surface portion along the finger gripping skirt of the sidewall.

In describing the overall invention, reference will be made to preferred embodiments illustrated in the accompanying drawings in which:

FIG. I is a perspective view of a container of the present invention;

FIG. II is a vertical sectional view along the axial center line of the container of FIG. I;

FIG. III is a partial, sectional view, of two nested containers of the type shown in FIGS. I and II;

FIG. IV is a view similar to FIG. III illustrating an alternate embodiment of the present invention; and

FIG. V is a partial, sectional, exploded view illustrating the shape and relationship between the lower sidewall portions of adjacently nested containers.

With reference to the drawings, wherein identical numerals refer to identical parts, there is shown in FIGS. I and II a thin wall, plastic, one-piece, drinking container or cup of the throw away type, broadly identified as 10. Container 10 generally comprises base 12, sidewall 14 generally extending upwardly and outwardly from base 12 in a frustoconical manner, forming open upper end 17 at the free end of sidewall 14. Sidewall 14 comprises middle finger gripping surface 16 having a relatively even outer surface, of major extent, diverging outwardly of the container axis at a substantially constant angle. By "major" herein is meant 40 to 90% of the total sidewall axial distance. Surface 16 may have a partially foamed outer surface portion 18, obtained in a manner to be hereinafter described. Sidewall 14 further comprises undulated anti-rub section 20 intermediate base 12 and gripping surface 16, and upper section 22, intermediate gripping surface 16 and open upper end 17. Upper section 22 has portions offset from the angle of gripping surface 16 to define nesting means formed therein, which, together with the lower undulated section of sidewall 14, cooperates with similar structure in a like container, as in FIGS. III and V, to positively maintain a radial clearance between the sidewalls of two nested containers.

The nesting means of upper section 22 of sidewall 14 comprises outwardly flaring arcuately shaped supporting shoulder 24, the upper edge of which integrally merges into an upwardly and inwardly tapering spacing skirt 26. Spacing skirt 26 is integrally formed with an upwardly and outwardly curving stacking shoulder 28 along its upper margin. As shown in FIG. III the point of integral adjoinment of stacking shoulder 28 and spacing skirt 26 forms an annular stacking edge 30. Stacking shoulder 28 integrally merges at its upper end into an upwardly extending upper sidewall 31. Rim 32 flares outwardly and consists of an upper rim forming wall 34 which merges into reversely bent flange 36, thereby defining an outer rim margin 38 as typically shown in FIGS. II and III.

Lower undulated section 20 of sidewall 14, as shown in FIGS. II and V, has corner chime 40 at the junction of sidewall 14 with base 12. Undulated section 20 further comprises first vertical surface 42 extending up from chime 40, parallel to the container axis, and at least one undulation 44, between the upper end of vertical surface 42 and the lower end of finger gripping surface 16, which diverges outwardly of the container axis at an angle of between about 10 to 15 degrees. Additional vertical extensions 46 and 48 (FIG. V) parallel to the container axis, as well as an additional undulation 50 outwardly diverging from the container axis at the same or different angle as that of portion 44 may be provided. At the junction of each vertical surface and outwardly diverging undulation, there is provided an annular antirub edge 52.

Slide line 54 of container 10 as depicted in FIG. III, is defined by a plane tangent to the outer surface at the point of maximum diameter in an upper section of the container above the mid point of the sidewall, and the outer surface of the radially outermost extremity of the lower section of the container below the sidewall mid-

point. These points need not necessarily be at the axial upper sidewall extremity or at the lower joint between the sidewall and base. Corner chime as used herein is meant to include the radially outermost extremity of the lower end of the container. In FIG. III slide line 54 is represented by a plane tangent to outer rim margin 38 of upper section 22, and the outside surface of corner chime 40 of lower undulated section 20.

Bottom wall 12 (FIG. II) may be of the double conical variety consisting of outer base ring 56 extending inwardly and upwardly, and inner base ring 58 which integrally merges into the outer base ring 56 and tapers further upwardly and inwardly toward the container axis. This double conical base design, wherein each of the portions tapers inwardly and upwardly at a different angle, provides an unusually strong bottom for container 10.

Container 10 after being formed in a suitable thermoforming operation such as by the process described in U.S. Patent No. 2,967,328 is foamed on a portion 18 of its sidewall 14, in accordance with the method described in U.S. Patent No. 3,262,625. Container 10 is suitably masked in those areas in which it is not desired to produce a foamed surface, and is then steeped by immersion in a suitable solvent such as trichlorofluoromethane for a period of approximately ten seconds. Thereafter, container 10 is withdrawn from this solvent, retained for an interval in dry room conditions, and then subsequently immersed into a hot water bath, or subjected to a hot air stream, or exposed to a steam environment, for a predetermined period of time. This procedure results in a foamed outer surface throughout the area of solvent immersion while the inner surface remains nonfoamed. Moreover, it has been found that partially foaming the surface of container 10 by this method may produce expansion of the plastic material by about two or more times the original sidewall gage. It has further been found by this procedure, that the overall structural properties of the container are not altered by this steeping operation, while its insulating properties are materially increased. In the present invention, sidewall 14 of container 10 is provided with an annularly extending foamed section 18 which extends to a point about $\frac{3}{8}$ inch above corner chime 40 of container 10, and to a point about 1 inch below its upper peripheral margin. The axial length of foam generally is between about 1 to 4 inches and preferably between 1.75 to 2.25 inches. The foamed section 18 has an overall thickness, measured from the outer surface of the finger gripping portion 16 extending outwardly, of about 0.01 to 0.02 inch, thereby rendering an overall sidewall and foamed section thickness of about 0.025 to 0.035 inch. By further reference to FIG. II and slide line 54, it can be seen that the foamed section 18 of container 10 is within slide line 54, and is so located that it will never come in contact with a straight wall surface against which the container is placed. Consequently, a container 10 passing along the inclined dispensing tube of a vending machine, will never contact the wall of the dispensing tube, except tangentially at corner chime 40 and outer rim margin 38.

Referring now in more detail to lower undulated section 20 of sidewall 14, it can be seen that by means of this design, lower end 56 of foamed section 18, or of the lower end of finger gripping skirt 16 when no foam is used, is incrementally inset more toward the container axis and thereby makes a greater angle with the axis than if it were extended straight down to corner chime 40. Slide line 54, however, is still defined by the plane passing through chime 40 and rim margin 38. As can be seen from FIG. III, this incremental increase in the angle of the finger gripping portion of the sidewall with the container axis improves the rapidity at which the inside non-foamed surface 59 of one cup falls away from foamed surface 18 of sidewall 14 of an adjacently nested unit. In other words, as the angle of sidewall 14 of container 10 with the vertical increases and approaches the hori-

zontal (90°) the distance of one sidewall from an immediately adjacent and parallel sidewall increases for a constant amount of vertical movement of the sidewalls. This effect is important in releasing a container from a stack, since it minimizes the vacuum effect occurring between two containers during denesting, which tends to hold them together, and prevents air from entering through the open end between the containers to break the vacuum. The angle which finger gripping portion 16 of sidewall 14 must make with the vertical, while still being designed for use in existing vending machines, may be defined as shown in FIG. III by θ , and follows the relationship $\sin \theta = d/h$ where d defines the length of a plane perpendicular to finger gripping portion 16, between the outer surface of the inner nested cup and the inner surface of the outer supporting cup, and is between about 0.002 to 0.030 inch, and h defines a plane perpendicular to d , also between the outer surface of the inner nested cup and the inner surface of the outer supporting cup, and is between about 0.050 to 0.200 inch.

Undulated section 20 of sidewall 14 permits incremental inseting of foamed portion 18 toward the container axis in order to maintain a clearance between the slide line and the lower end 56 of the foam to compensate for any variation in the foam thickness or irregularities in the chute surface. For an equivalent clearance in each case of about 0.015 inch between the lower edge 56 of the foamed surface and the container slide line, the undulated design as depicted in FIG. II permits an increase in the axial length of foam by about 21% over that possible with a comparable straight sided container without an undulated bottom. Similarly, the foam thickness may also be increased up to twice the thickness possible with a comparably constructed straight sided cup without an undulated bottom if a comparable increase is made in the stacking height (vertical distance between two equivalent points in adjacently nested containers) of the containers. This vastly improves the insulating properties of the cup without changing the common container slide line in each case.

The particular design of undulated section 20 is also important from a mold release standpoint. Each undulation (e.g., 44) of section 20 makes a positive angle with the container axis, in that it diverges outwardly from vertical surfaces 42, 46 and 48 which are parallel to the container axis. The outermost extent of undulations 44 and 50, however, are within slide line 54 and accordingly do not interrupt it. This positive angle enables the container to be simply removed axially from its forming mold without having to flex the plastic sidewall inwardly, to move any negative, reversely angled inwardly tapering portions beyond their corresponding wall defining portions of the mold. This is especially significant when dealing with sidewall portions adjacent the bottom of the container, since the extent to which the wall may be flexed in this area to permit removal of reversely angled portions from the mold is less than that at the opposite, open, more flexible and free end of the sidewall where rigidity is not as great.

In use, container 10 is readily adaptable to being nested and stacked with a series of like containers in the manner as shown in FIGS. III and V. When placed in the nested position, it can be seen that the outer surface of the supporting shoulder 24 is engaged by the annular stacking edge 30 of stacking shoulder 28. As a feature of the present invention, as illustrated in FIG. IV, the upper end of the finger gripping section of the container sidewall may join the supporting shoulder at a greater angle with the cup axis than is the remainder of the sidewall. This feature, in conjunction with the antirub undulated bottom section, positively insures that the formed outer surface of container 10a cannot contact the non-foamed inner surface of outer container 10b, since lateral, angled supporting shoulder 24a of container 10a minimizes lateral sliding when the containers are nested within each

other. The angle of supporting shoulder 24a is typically shown as α in FIG. IV, and may be between about 30 to 75 and preferably 40 to 50 degrees. When α exceeds 75 degrees lateral top sliding may occur, while telescoping may occur when α is less than 30 degrees, i.e., a tendency of the stacked cups to be forced down within each other for any appreciable top loading of the stack. By means of this feature the possibility is eliminated of initially vertically stacking the containers in axial alignment though displaced slightly laterally, so as to cause undesirable sticking within the vending machine, particularly around the upper portions of the foamed sidewall.

In the event of any tendency of the inner nonfoamed surface of an outer cup to move inward toward the foamed surface of the inner cup or vice versa, because, for example, of drag movement during transfer of nested stacks within the vending machine, nonfoamed, outer antirub edge 52 of the inner cup will contact the non-foamed inner surface of the undulated bottom section of the outer cup as depicted in FIG. V, to maintain the desired sidewall clearance of the foamed portion of the inner cup from the nonfoamed portion of the outer cup. Contact is in an edgewise manner as depicted in FIG. V rather than surface to surface contact, in order to minimize any frictional drag even between the relatively slippery nonfoamed portions of the lower undulated sections.

The above description and particularly the drawings are set forth for purposes of illustration only and are not to be taken in a limited sense.

The undulated, antirub wall structure of the lower portion of the container sidewall of the present invention, in conjunction with the nesting means in the upper end of the container sidewall may be used in any situation where it is desirable to maintain a clearance between surfaces of nestable containers. It may, for example, be used to keep printed indicia, advertising designs or labeled surfaces from scuffing and marring during rough handling or vibratory movement in bulk shipping. The combination is particularly adaptable and preferably used with nestable containers having foamed surfaces with high coefficients of friction, which present difficult denesting problems, particularly in automatic dispensing machine operations. The invention is equally applicable to partially foamed integral one-piece containers prepared as described in U.S. Patent No. 3,262,625, as well as to multiple piece containers having separately adhered foamed insulating sleeves on the outside of the container.

The undulated structure is desirably continuous around the full periphery of the container, but may be interrupted, with nonundulatory smooth peripheral portions spaced between the undulated sections.

The undulated nonfoamed bottom section may be of any total length, depending on the desired extent of the finger gripping portion of the container sidewall. The length in the vertical of individual angled sections may be equal or different. This section, however must contain at least one outwardly diverging undulation which makes a positive angle of divergence from the container axis which is greater than that of the finger gripping sidewall portion but less than 180 degrees, and preferably between 5 to 90 degrees, and terminates either at or radially within the container slide line, as defined by a plane passing through the container upper rim and the bottom corner chime.

The material from which the container is formed may be of any material of sufficient strength to be fabricated relatively thinly for economy purposes, since the type of container contemplated is the thin wall, throw away type. Typical materials are paper, cardboard, metals, etc., including any combination of two or more of such materials. Plastic is preferred since such containers do not become soggy when holding liquids, have a pleasing feel to the lips of a user, and have improved vapor barrier properties, which minimizes condensation of moisture on

outside surfaces when cold materials are confined therein. Any common method of manufacture may be employed which is most suitable to the particular material being processed. It is preferred, in the present invention that the container be made of thermoplastic, which has the additional advantage of being tough and unbreakable under ordinary use conditions. The preferred forming method is from web stock by any of the well known sheet thermoforming processes, such as, for example, pressure differential forming, using vacuum or positive pressure, and with or without a plug assist. The resulting container when formed in this manner is seamless and unitary in construction, and is of the thin wall variety having a non-foamed wall thickness between about 2 to 80 mils, which is substantially uniform throughout the entire extent of the container. Styrene-based thermoplastics are preferred for manufacturing the containers of the present invention, since even when thin, this material is unusually tough.

The containers of the present invention may be of any geometrical configuration as long as they have nestable features for cooperating with a lower undulated antirub sidewall section. Otherwise the cup may be round, square, hexagonal etc. and may have any number of sides.

The present invention provides a unique nestable container suitable for use in holding various liquids dispensed from automatic vending machines. The nesting means and lower undulated section combination provides the following advantages:

(1) Provides a trouble free wall design for positively maintaining a radial clearance between sidewalls of nested containers under all circumstances, no matter how firmly stacked together or laterally moved they may be when in nested form;

(2) Permits increasing the axial sidewall length of insulating foam by about 21%, and doubling its thickness over that for a comparable container having a straight sidewall, in the case of partially foamed insulated containers, while still permitting their use in existing vending machine designs;

(3) Incrementally increases the angle of the sidewall gripping section with the vertical to facilitate denesting movement of two like containers;

(4) Provides the above-mentioned improvements without the use of a negative angled sidewall portion, to insure trouble free removal of the container from its forming mold;

(5) Provides the above-mentioned improvements without disturbing the traditional container slide line used in vending machine cup transfer chutes.

It will be understood that numerous changes may be made in the design and construction thereof without departing from the spirit and scope of the invention.

What is claimed is:

1. A thin wall, nestable container having a base, and a sidewall generally extending upwardly and outwardly from the base forming an open upper end, said sidewall comprising a gripping surface of major extent diverging outwardly in relation to the container axis at a substantially constant angle, a lower undulated section intermediate the base and the gripping surface comprising at least one upwardly and outwardly diverging undulation merging at its upper end with a wall portion of said lower section which is substantially parallel to the container axis, and an upper section of said sidewall intermediate the gripping surface and the upper end, said upper section having nesting means formed therein, said nesting means and undulated section being adapted to cooperate with a like container when one of such containers is supported within another of said like containers to maintain a radial clearance between the sidewalls of the two containers.

2. The container of claim 1 wherein the angle of the gripping surface with the cup axis is defined as θ and follows the relationship

$$\sin \theta = d/h$$

where d defines a plane perpendicular to said gripping surface between the outer surface of an inner nested cup and the inner surface of an outer supporting cup, and is between about 0.002 to 0.030 inch, and h defines a plane perpendicular to d between the outer surface of an inner nested cup and the inner surface of an outer supporting cup, and is between about 0.050 to 0.200 inch.

3. The structure of claim 1 wherein the container is formed from thermoplastic sheet to provide a seamless unitary construction having a sidewall thickness between 2 to 80 mils.

4. A thin wall nestable plastic container having a base, a sidewall generally extending upwardly and outwardly from the base forming an open upper end, an outwardly extending rim at the top of said sidewall, said sidewall comprising a finger gripping mid portion of major extent diverging outwardly in relation to the container axis at a substantially constant angle with the axis, a lower undulated section between the base and said mid portion comprising at least one upwardly and outwardly diverging undulation merging at its upper end with a wall portion of said lower section which is substantially parallel to the container axis, and an upper section between the rim at the top of the sidewall and the gripping portion, said lower section having a corner chime at the joint between the sidewall and the base, a plane tangential to the outer surface of said rim and the outer surface of said chime defining a container slide line, the angle of said slide line with the container axis being different from that of the mid portion of the sidewall, said upper section of the sidewall having nesting means which, together with the undulated section, cooperate to maintain a radial clearance between the inner surface of the gripping section of a first container, and the outer surface of the gripping section of a like container when nested within said first container.

5. The container of claim 4 wherein a portion of the outer surface of the gripping section is foamed.

6. The container of claim 5 wherein the length of the foamed section is between about 1 to 4 inches.

7. The container of claim 5 wherein the foam is inset of the slide line.

8. A thin wall nestable plastic cup having a base, a sidewall having a nonfoamed inner surface, said sidewall generally extending upwardly and outwardly from the periphery of the base to form an open upper end, a curled rim projecting outwardly from the top of the sidewall, said sidewall comprising a finger gripping portion of major extent having a foamed outer layer, said gripping portion diverging outwardly in relation to the container axis at a substantially constant angle with the axis, said sidewall further comprising a lower section bounding the lower end of the foamed gripping portion, said lower section having at least one upwardly and outwardly extending undulation merging at its upper end into a wall portion of said lower section which is substantially parallel to the container axis, and a corner chime at the junction of the sidewall and the base, a plane through the outer surface of said rim and the outer surface of the chime defining a container slide line, said foamed outer layer of the gripping portion and the outermost extremity of the undulation being substantially within said slide line, said sidewall further comprising an upper section between the rim at the top of the sidewall and the gripping portion, said upper section having nesting means formed therein which cooperate, together with the outermost edge of the undulation of the lower section, to maintain a radial clearance between the foamed outer surface of the gripping section of said cup, and the inner, nonfoamed sidewall surface of a like cup within which said cup is nested.

9. The structure of claim 8 wherein the angle of the undulation with the cup axis is greater than the angle with the cup axis of the finger gripping portion but less than 180 degrees.

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10. The cup of claim 8 wherein the nesting means of the upper section comprises an annularly extending stacking shoulder spaced downwardly from the open upper end, and an annularly extending supporting shoulder spaced downwardly from said stacking shoulder, the supporting shoulder of one cup being sized to rest on the stacking shoulder of a like cup when one cup is supported within another like cup. 5

11. The structure of claim 10 wherein the cup is of one-piece construction. 10

12. The container of claim 11 wherein the supporting

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shoulder joins the gripping section at an angle with the cup axis of between about 30 to 75 degrees.

References Cited

UNITED STATES PATENTS

3,374,922	3/1968	Shelby -----	229—1.5
3,139,213	6/1964	Edwards -----	229—1.5

DAVID M. BOCKENEK, Primary Examiner

U.S. Cl. X.R.

220—97