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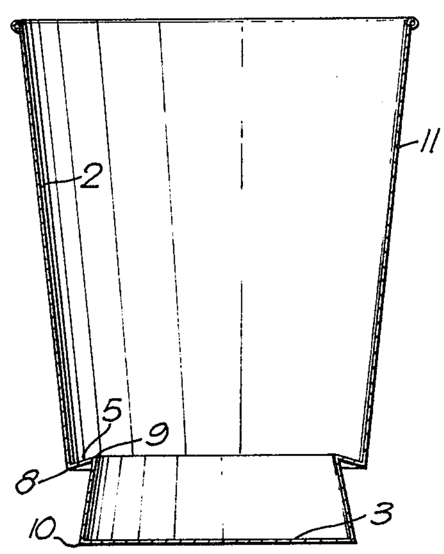
(54) **Nestable containers.**

(57) A nestable cup 11 or other container comprises a bottom 3 and a side wall 2, and includes stacking means comprising an external, downwardly-facing shoulder 3 and an internal, upwardly-facing shoulder 5. The internal upwardly-facing shoulder 5 is inclined in a direction downwards and outwards and terminates at an acute-angled sharp convex corner 9. When a plurality of identical cups or other containers 11 are assembled together into an upright stack, the corner 9 makes localised contact with the external, downwardly-facing shoulder 3, of the cup 11 or other container above the corner 9 engaging the downwardly-facing shoulder 3 away from its edge 10. Any vertical shock loading applied to a stack of such cups 11 or other containers is cushioned by resilient deformation of the external, downwardly-facing shoulders 3.



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Lin Pac Plastic Containers Limited

NESTABLE CONTAINERS

Thin-walled plastics cups and other containers are now commonplace. For transport, e.g. from a place of manufacture to a place of use, such cups or other containers are nested together to form stacks. The cups or other containers in such nested stacks tend to jam together and in an attempt to overcome this each cup or other container has been provided with stacking means. Such stacking means comprises an internal upwardly-facing surface and an external downwardly-facing surface. The surfaces are located in planes normal to the central axis of the cup or other container. In an upright stack the external surface of each intermediate cup or other container rests on the internal surface of the cup or other container below, whilst its internal surface supports the external surface of the cup above. Such stacking means are sufficient to ensure that the cups or other containers do not jam together when a stack is formed and handled carefully. However, when such a stack is subject to an axial shock load by being jolted, for example when a case of such stacks is unloaded from a vehicle or is subjected to vibration during transport; the outer edge of the external downwardly-facing surface of one cup or other container overrides the inner edge of the internal upwardly-facing surface of the cup or other container below. This jams the two cups or other containers together tightly and this presents a major problem when the two cups or other containers are to be separated by automatic machinery. This problem is particularly significant with a stack of cups which is packaged with ingredients in each of the cups. Such cups are known as ingredient cups and typically the ingredient is a powder which will provide a beverage when an inidividual cup is removed from the stack and filled with hot water. The additional weight of the ingredient means that the weight of each stack is greater than the weight of a corresponding stack of empty cups. Thus stacks of ingredient cups are more prone to jamming during transport or when they are unloaded from a vehicle.

According to this invention a nestable cup or other container comprises a bottom and a side wall, and includes stacking means comprising an external, downwardly-facing shoulder and an internal, upwardly-facing shoulder, the internal upwardly-facing shoulder being inclined in a direction downwards and outwards and terminating at an acute-angled sharp convex corner so that, when a plurality of identical cups or other containers are assembled together into an upright stack, the corner makes localised contact with the external, downwardly-facing shoulder of the cup or other container above the corner engaging the downwardly-facing shoulder away from its edge.

Any vertical shock loading applied to a stack of such cups or other containers is cushioned by resilient deformation of the external, downwardly facing shoulders. Further, since the internal, upwardly-facing shoulder is inclined outwards and downwards, after the external shoulder has been deformed, both shoulders are inclined outwards and downwards and therefore axial shock loading between these surfaces generates forces tending to expand the external shoulder and contract the internal shoulder, so resisting the external shoulder overriding the internal shoulder.

The internal upwardly facing shoulder may be castellated with alternate lands being inclined. In this way the lower edge of the inclined lands merge with the lands that lie in a plane normal to the axis of the cup or other container and thus the downwardly facing shoulder of the cup above rests on the acute-angled sharp convex corners at the upper ends of the inclined lands. When a stack of such cups is subjected to axial shock loads the downwardly-facing shoulder is deformed only in the areas in engagement with the upper ends of the inclined lands. This deformation absorbs the shock loading and then the lands lying in a plane normal to the axis of the cup or other container are engaged by the remainder of the downwardly facing shoulder of the cup or other container above and this provides a positive stop. Again the deformed parts of the downwardly facing shoulder of the cup or other container above and the inclined lands generate forces tending to expand the external shoulder so resisting the external downwardly facing shoulder overriding the internal upwardly facing shoulder.

The internal upwardly facing shoulders of the stacking means may be located anywhere along the side wall of the cup or other container. In ingredient cups, the internal upwardly facing shoulder is usually located at and used to define the top of the ingredient packet in the cup or other container. In this case it is preferred that the inner upwardly facing shoulder is formed by a continuous annular downwardly and outwardly inclined surface. With such a construction a continuous seal is provided all around the upper corner of this surface and the downwardly facing shoulder of the cup or other container above so holding the ingredient in its pocket and preventing its migration during transport and handling.

Another way in which the resistance to the overriding of the stacking means can be increased is for the side wall of the cups or other containers to include a plurality of circumferentially spaced externally projecting nibs arranged so that when a plurality of identical cups or other containers are nested to form an upright stack, the nibs are very close to, or touch, the interior of the side wall of the next cup below. Some of any axial shock loading applied to the stack is absorbed by resilient deformation of the side wall where it is engaged by the nibs and also the nibs help in centralising the cups or other containers in the stack so that there is the optimum overlap between the stacking means of adjacent cups or other containers. Preferably the base of each nib is also inclined downwardly and outwardly and this helps increase the digging in effect of the nib into the side wall of the cup or other container below and so increases its resistance to overriding of the stacking means still further.

Whilst these cups and other containers are specifically intended to be used with thin-walled plastic cups, they can also be applied to all manner of thin-walled, thick-walled, multi-walled, lockable, jamming, non-lockable and stackable containers, made of a variety of materials such as plastics or paper, using a variety of manufacturing techniques provided that the downwardly facing shoulders of the stacking means have some inherent resilience so that they can deform to absorb any axial shock loading.

Typically when made from a plastics material the cups or other containers are made from high impact polystyrene, other grades of polystyrene, polypropylene, or polyvinyl chloride. Such plastics cups can be made by well-known techniques, in particular using the "Hannifin cycle" or the "Illig cycle". In each case the shape of the cup is determined by the shape of the cavity in a female mould, which operates as a rigid unit apart from an ejector in its base. The deformation of a heated sheet of plastics is started mechanically by a plug, and is finished by the admission of air under pressure to the interior of a pre-form created by the plug. There is no use of vacuum and thus the apparatus is simple.

Preferably the corners of the mould which produce the sharp acute-angled corner along the upper edge of the internal upwardly facing shoulder has a radius in cross section not exceeding 0.25 mm, and the corners in the mould which produces the other corners at the edges of the upwardly and downwardly facing shoulders also have a radius in cross section not exceeding 0.25 mm.

Preferably the surface of the mould which forms the inner upwardly facing shoulder is inclined downwards and outwards at an angle of 7° to the horizontal. This angle may be varied within the range 5° to 10° to the horizontal.

Particular examples of plastics cups in accordance with this invention will now be described and contrasted with the prior art with reference to the accompanying drawings; in which:-

Figure 1 is a sectional elevation through two conventional ingredient cups nested together;

Figure 2 is a sectional elevation through two nested ingredient cups which have become jammed together;

Figure 3 is a sectional elevation through one ideal form of ingredient cup;

Figure 4 is a sectional elevation through a first example in accordance with this invention;

Figure 5 is a section through two of the first example of ingredient cups in accordance with this invention nested together;

Figure 6 is a section through two of the first example of ingredient cups nested together illustrating the deformation of the cups caused by axial loading;

Figure 7 is a perspective view of a second example of cup in accordance with this invention;

Figure 8 is a section through two cups in accordance with the second example of this invention nested together;

Figure 9 is a section through two of the second example of cups in accordance with this invention nested together and subjected to an axial loading;

Figure 10 is a sectioned perspective view of a third example of cup in accordance with this invention;

Figure 11 is a section through two of the third example of cups in accordance with this invention nested together; and,

Figure 12 is a section showing a modification of the third example.

Figure 1 shows two known nested ingredient cups 1A and 1B under normal conditions. Each comprises a side wall 2, a base 3 and an annular shoulder 4 extending in a plane normal to the axis of the cup. The base 3 of cup 1A sits on the inner upwardly-facing surface of shoulder 4 of cup 1B. An ingredient pocket 6 is formed between the cups 1A and 1B and in use, these contain a beverage powder 7.

Figure 2 shows the effect of an excessive axial load on a nested stack of such cups. The external corner around the periphery of the base 3 of the cup 1A has overridden the internal corner around the periphery of the shoulder 4 of cup 1B and so jammed itself into the ingredient pocket 6 of cup 1B.

The resistance to jamming of such a stack of cups to an axial shock is a result of the relationship between the degree of overlap between the shoulder 4 and the base 3 of the next cup in the stack. If the degree of overlap shown as X in Figure 3 is made sufficiently large and the corners 8, 9 and 10 made sufficiently sharp, then this problem can be overcome. To obtain maximum benefit from the overlap X the corner 10 needs to be sharp on the outside of the cup whilst the corner 9 needs to be sharp on the inside of the cup. The effectiveness of the overlap also depends upon the cups being located concentrically in the stack by co-operation between the corner 10 and the inside of the corner 8. However, to produce cups of this nature using standard pressure-forming techniques is virtually impossible because of the problem of ensuring sharp corners and the subsequent ejection of the cups from a mould in which they are formed. In the past, this has led to the development of complicated and expensive techniques such as vacuum assisted pressure-forming and drop-based tooling. Figure 4 shows a cup in accordance with this invention formed as an ingredient cup 11. The annular shoulder 5 between the corners 8 and 9 has a downward and outward slope. Figure 5 shows a stack of two such cups 11A and 11B and nested together. The sharp acute-angled corner 9 at the inside of the downwardly and outwardly inclined annular shoulder 5 of the cup 11B engages the base 3 of the cup 11A away from its outer corner 10. A circular line contact is established between the two cups to define the ingredient pocket 6. The shoulder 5 is inclined at 7° to a plane normal to the axis of the cups.

When an axial load is applied to a stack of such cups an upward force is transmitted by the corner 9 of cup 11B to the base 3 of cup 11A away from the corner 10. As the load is increased the upward force causes an upwards distortion in the base 3 of cup 11A until the corner 10 engages the face of the shoulder 5. Thus, the first thing that happens in the event of a stack of such cups being subjected to an axial load is that the base 3 distorts to absorb some of the axial load. Any further increase in the axial load involves forces being transmitted over zones of the base 3 of the cup 11A and the shoulder 5 of the cup 11B. These zones are in face to face inter-engagement as shown in Figure 6 and each has a significant extent in the radial direction. Because of the initial downward and outward slope of the shoulder 5 of cup 11B and the deformation of the base 3 of cup 11A both of these zones are inclined downwards and outwards and hence further axial loading results in the base 3 of the cup 11A tending to expand whilst the shoulder 5 of cup 11B tends to contact and these forces interact to positively prevent overriding of the corner 10 over the corner 9 and as shown in Figure 2. Thus, the inclination of the shoulder 4 positively prevents the jamming of a stack of nested cups together.

A typical cup as shown in Figures 4, 5 and 6 may be of 7 fluid ounce (200ml) capacity, may be made by thermoforming from a sheet of high impact polystyrene having an initial thickness of 0.8mm. Each cup uses a disc 74.5mm in diameter. The cups are made using the "Hannifin" or "Illig" cycle. In these the deformation of the heated sheet is started mechanically by a plug and is finished by the emission of air under pressure into the interior of the preform created by the plug. Preferably the corners in the mould which produce the corners 8, 9 and 10 in the cup all have radii in cross section not exceeding 0.25 mm. It is preferred that for most of the particular cup the measurements of the vertical centre line of the mould are as follows:-

to the corner forming corner 8 of the cup	30.00 mm
to the corner forming corner 9 of the cup	29.00 mm
to the corner forming corner 10 of the cup	29.75 mm.

In the finished cup the thickness of the sheet around the shoulder 4 in the baseof the cup 3 is preferably nowhere less than 0.15 mm.

The second example of cup in accordance with this invention is shown in Figure 7 and in this second example the continuous annular shoulder 5 is interrupted to form a castellated shoulder. First, in this example a series of lands 5 inclined to a plane normal to the axis of the cup is intercollated with lands 4 which lie in a plane normal to the axis of the cup. A normal stack of such cups is shown in Figure 8 and the base 3 of cup 12A is normally supported on the edges 9 the inside edge of the inclined lands 5. When the stack of cups is subjected to an axial load the base 3 of the cup 13A is subjected to local deformation as shown in Figure 9 in an analogous fashion to that of the first example and this deformation of the base 3 of the cup 12A absorbs the shock of any axial loading. After the base 3 of the cup 12A has been deformed the corner 10 moves down into contact with the corner 8 to provide a positive stop. This is the position shown in Figure 9. Again the deformed parts of the base 3 resting against the inclined lands 5 tend to cause the corner 10 to expand circumferentially and the corner 9 to contract circumferentially so tending to oppose overriding of the corner 10 over the corner 9.

A third example of cup in accordance with this invention is shown in Figure 10. The third example of cup 13 is an ingredient cup and generally similar to the first example but includes a number of radially extending nibs 14 located immediately above the inclined annular shoulder 5. The nibs 14 are arranged so that there is minimal or possibly zero clearance between the apeces of the nibs 14 of cup 13A and the side wall 2 of cup 13B when cup 13A is nested inside cup 13B as shown in Figure 11. When the stack of such cups is subjected to an axial load the outer periphery of the base 3 distorts in a similar fashion to that already described with regard to the first and second example in accordance with the invention. At this point the apeces of the nibs 14 on the cup 13A begin to and deform the side wall 2 of the cup 13B. This digging in and deformation provides an additional force to absorb the shock of any axial load and decreases the restoring force to return the cups to their normal nested configuration. The nibs 14 also have the effect of centralising the cups together with again helps to prevent the corner 10 overriding the corner 9 as a result of any misalignment between adjacent cups of the stack.

A modification to the third example is shown in Figure 12 and in this modification the nib 14 has a steeply inclined base 15. The steeply inclined base 15 increases the sharpness of a corner 16 between the apex of the nib 14 and its base and helps to increase the digging in effect of the nib 14 into the side wall 2 of a cup below it in a stack, thus increasing its resistance to impaction still further.

For the sake of clarity, only two cups have been shown throughout this description to represent a stack of cups and any locking means to lock together the cups into a stack has been omitted. In practice, a stack of ingredient cups after being filled with ingredient powder 7 is usually encased in a sheath of plastics film and then a number of such stacks are packaged in a cardboard case before being transported.

CLAIMS

1. A nestable cup or other container comprising a bottom (3) a side wall (2) and stacking means including an external, downwardly-facing shoulder and an internal, upwardly-facing shoulder (4), characterised in that the internal upwardly-facing shoulder (5) is inclined in a direction downwards and outwards and terminates at an acute-angled sharp convex corner (9) so that, when a plurality of identical cups (11,12,13) or other containers are assembled together into an upright stack, the corner (9) makes localised contact with the external, downwardly-facing shoulder (3) of the cup (11A, 12A, 13A) or other container above, the corner (9) engaging the downwardly-facing shoulder (3) away from its edge (10).

2. A cup or other container according to claim 1, in which the internal upwardly-facing shoulder is castellated with lands (5) being inclined outwards and downwards and lands (4) lying in a plane normal to the axis of the cup or other container.

3. A cup or other container according to claim 1, in which the internal upwardly-facing shoulder is formed by a continuous annular downwardly and outwardly inclined surface (5).

4. A cup or other container according to any one of the preceding claims which also includes a plurality of circumferentially spaced externally projecting nibs (14) arranged so that when a plurality of identical cups (13) or other containers are nested to form an upright stack, the nibs (14)

are very close to, or touch, the interior of the side wall (2) of the next cup below.

5. A cup or other container according to claim 4, in which the base (16) of each nib (14) is also inclined downwardly and outwardly.

6. A cup or other container according to any one of the preceding claims, made from high impact polystyrene, other grades of polystyrene, polypropylene, or polyvinyl chloride.

7. A cup or other container according to any one of the preceding claims, in which the inner upwardly-facing shoulder (5) is inclined at an angle of within a range of 5° to 7° to a plane normal to the axis of the cup or other container.

8. A cup or other container according to any one of the preceding claims, when made from plastics sheet material by a pressure forming technique in a female mould having corners with radii in cross-section not exceeding 0.25 mm.

9. A cup or other container according to claim 8, in which the initial thickness of the sheet of plastics material is substantially 0.8 mm and, after forming, the thickness of the stacking means (3, 4, 5) is nowhere less than substantially 0.15 mm.

Fig. 1.

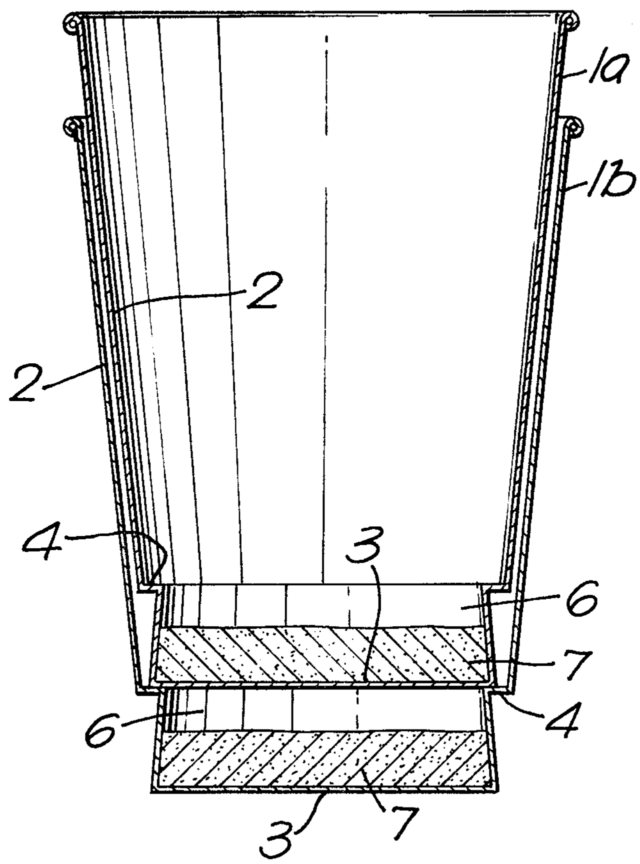


Fig. 2.

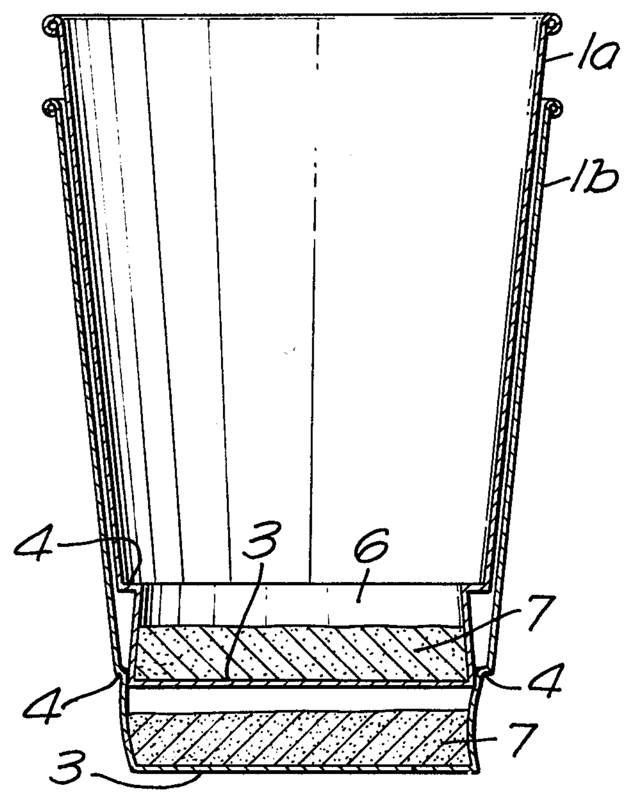


Fig. 3.

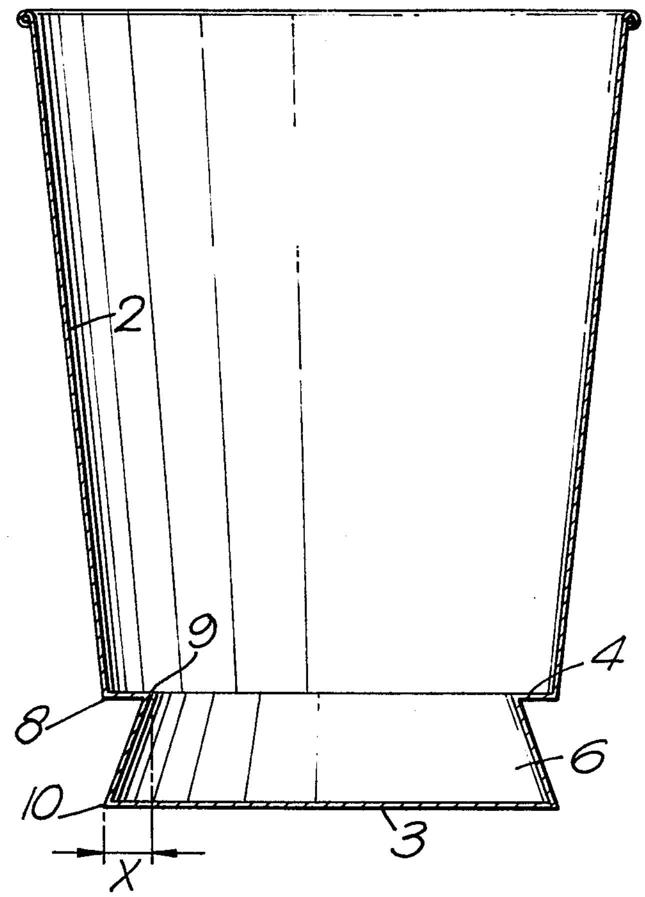
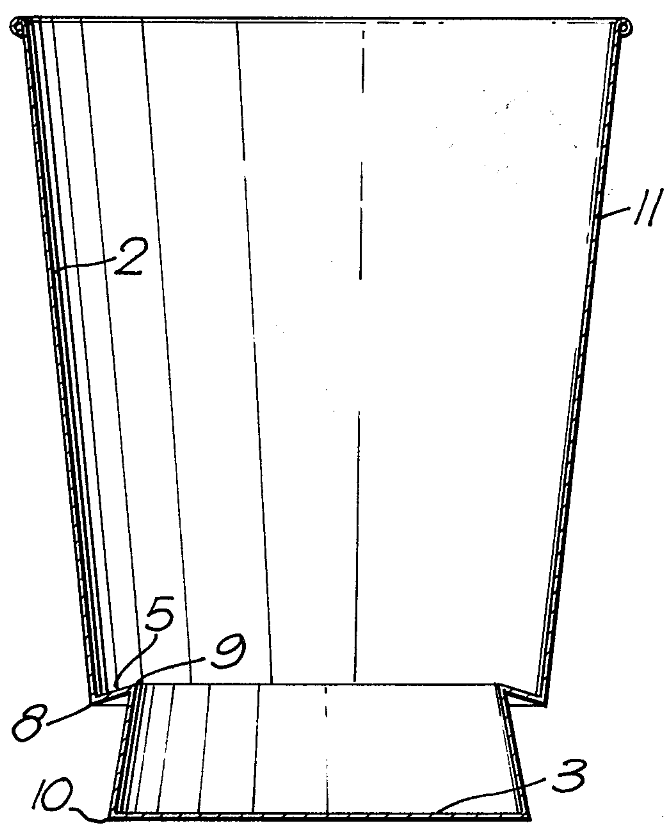


Fig. 4.



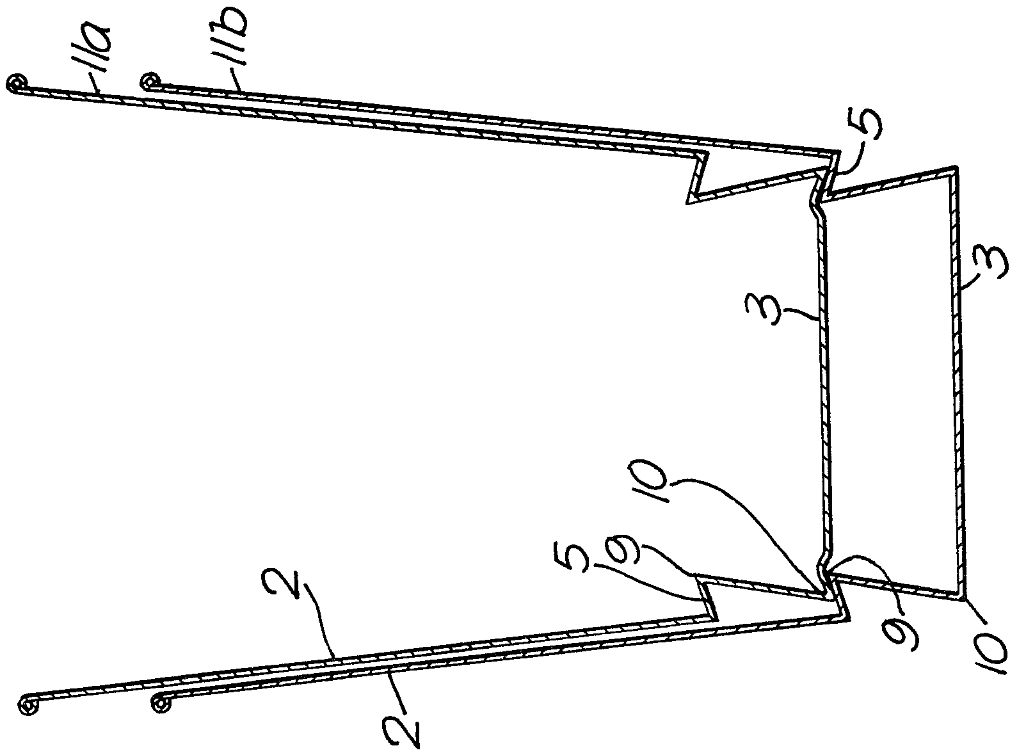


Fig. 6.

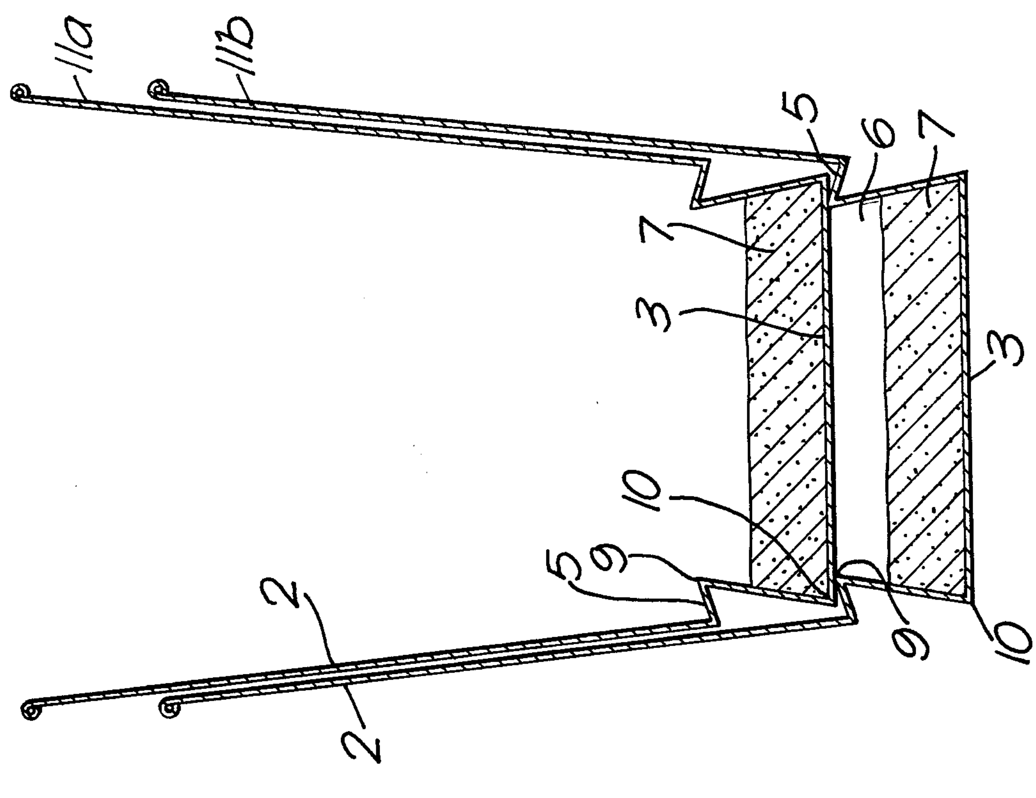


Fig. 5.

Fig. 7.

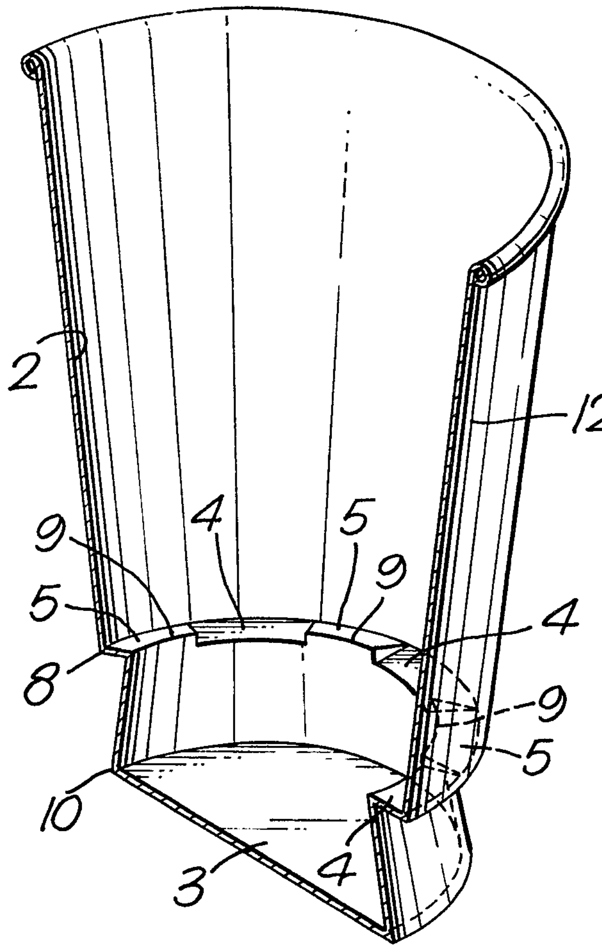


Fig. 10.

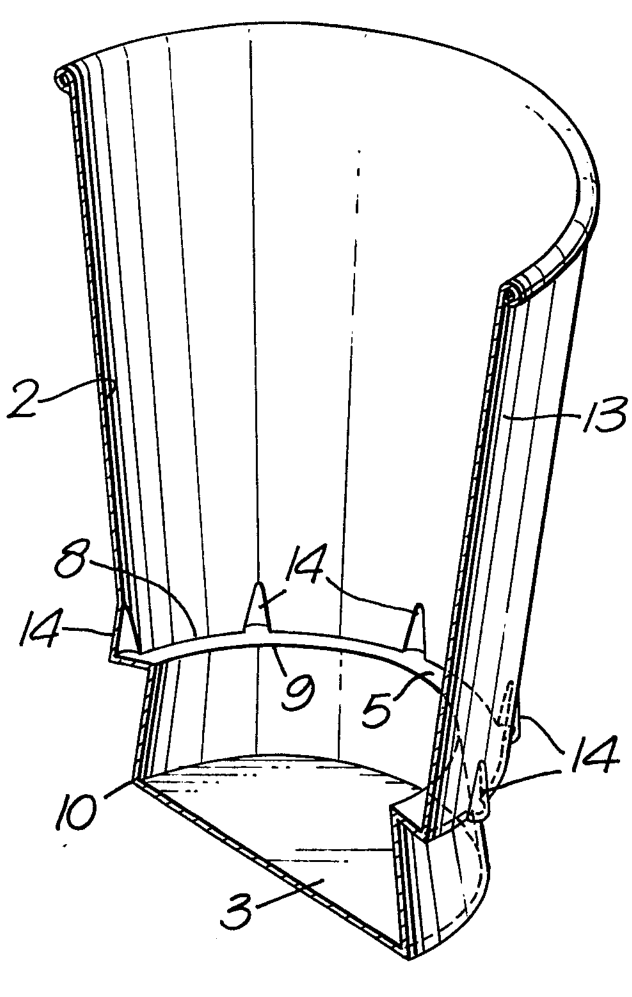


Fig. 9.

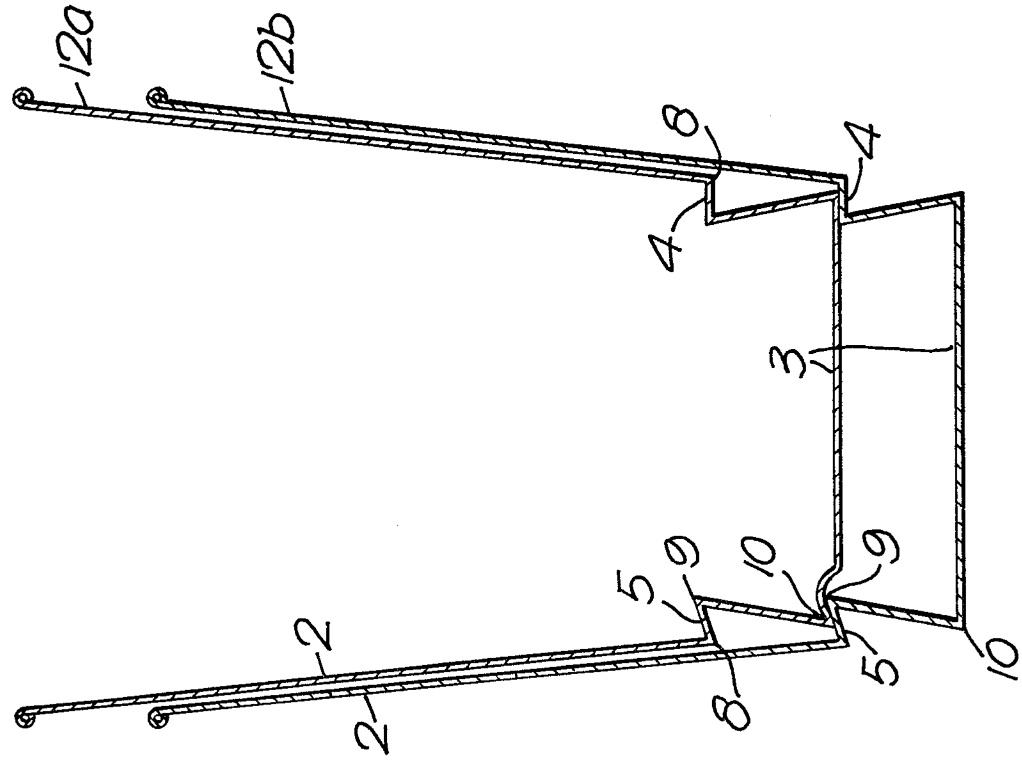


Fig. 8.

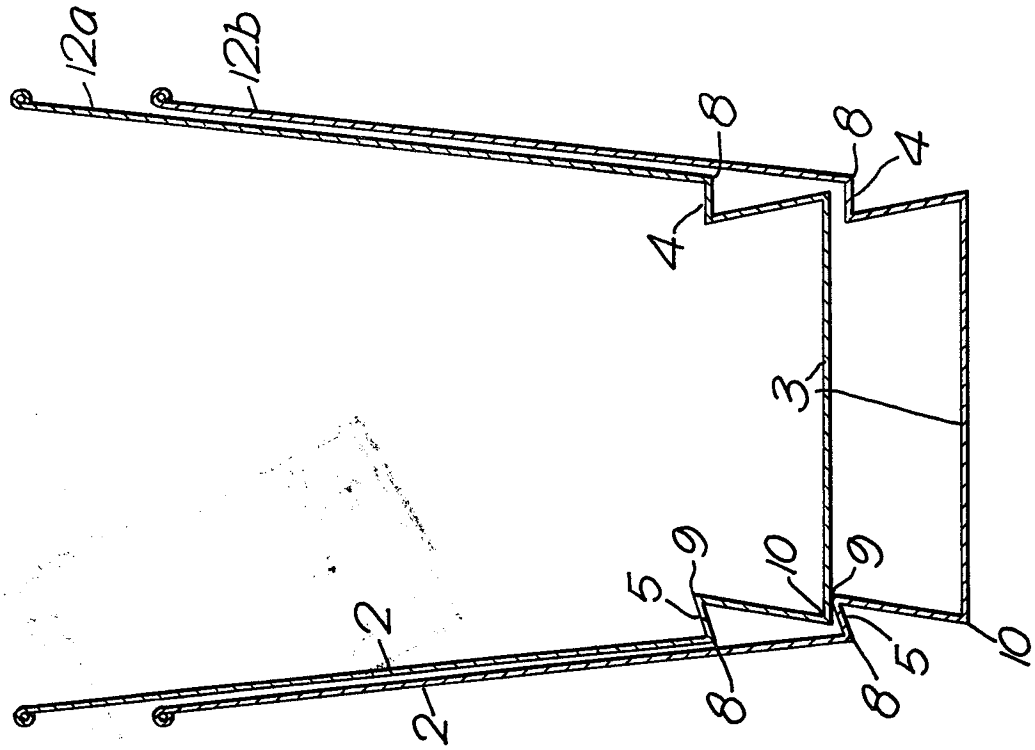


Fig. 11.

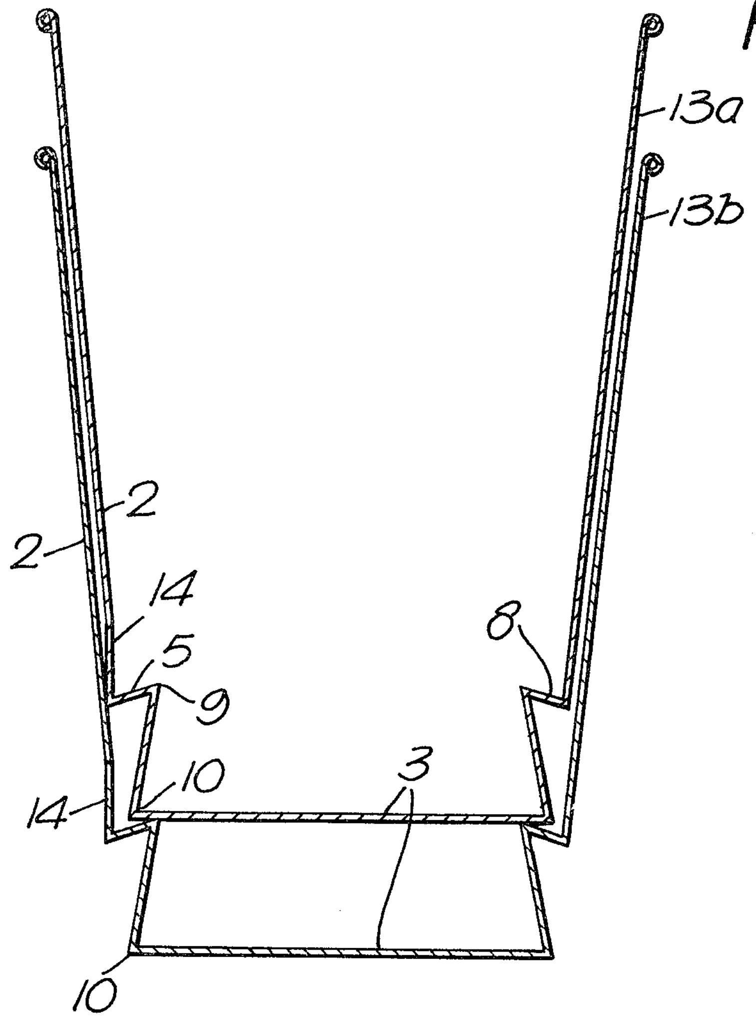


Fig. 12.