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CUP

Original Filed May 9, 1957

Fig. 1

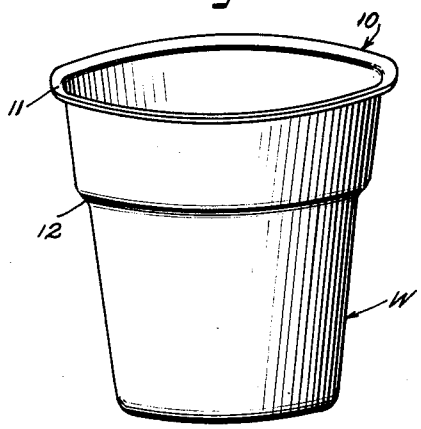


Fig. 2

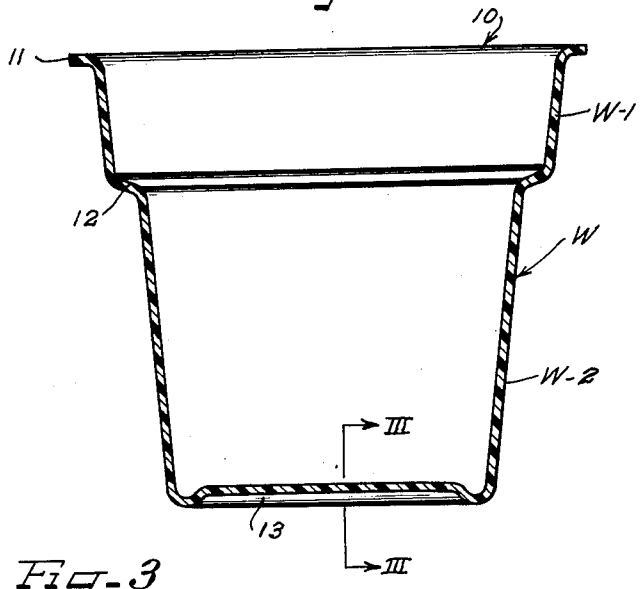
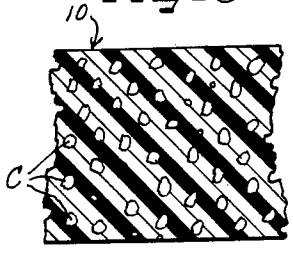


Fig. 3



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Original application May 9, 1957, Ser. No. 658,155, now Patent No. 2,942,301, dated June 28, 1960. Divided and this application Dec. 3, 1959, Ser. No. 2,318

1 Claim. (Cl. 229—1.5)

The instant invention relates to receptacles, and more particularly, to a unique receptacle structure formed of foamed polystyrene.

The present application is a division of our application Serial No. 658,155, filed May 9, 1957, now Patent No. 2,942,301.

The formation of foamed resins is known generally and, for example, as indicated in U.S. Patent No. 2,023,204, issued to Munters and Tandberg and U.S. Patent No. 2,450,436, issued to McIntire, the manufacture of foamed polystyrene is well known. The instant invention, however, resides in a particular structure formed of highly vesiculated lightweight polystyrene composed of closed cells, in which the structure is in the form of a receptacle, having been formed from a flat sheet by hot-drawing.

The resulting receptacle has unique properties and is economically manufactured so that it is competitive with paper cups or receptacles and has distinct advantages thereover in its physical properties. For example, the instant material is very lightweight and, although it is hot-drawn or formed from a flat sheet into the receptacle shape, the insulating properties thereof are not lost. Instead, the instant receptacle has such distinctly superior heat insulative properties that the cup may be retained in the hand, even though boiling water is poured into the cup. The instant material is, of course, moisture-proof. The cells therein are closed cells, so that moisture permeation is prevented and the advantages of insulation are retained. The instant material is also grease-resistant. The instant material is also distinctly superior to paper cups in that it does not impart a taste to beverages (particularly alcoholic beverages) retained therein. In contrast, the usual wax-coated paper cup is not sufficiently resistant to alcoholic beverages to prevent imparting taste thereto. Although the foamed polystyrene sheet material from which the instant receptacle is formed is very thin and lightweight, the instant cup is quite strong, easily as strong as paper cups, and is self-supporting under the weight of the liquid therein.

It is, therefore, an important object of the instant invention to provide an improved receptacle.

It is another object of the instant invention to provide a superior cup for retaining liquids, which is highly resistant to liquid permeation.

Still another object of the instant invention is to provide an improved cup formed of grease-proof, moisture-proof, lightweight, heat insulative foamed polysytrene.

Other and further objects, features and advantages of the present invention will become apparent to those skilled in the art from the following detailed disclosure thereof and the drawings attached hereto and made a part hereof.

On the drawings:

FIGURE 1 is a view in perspective of a receptacle embodying the instant invention;

FIGURE 2 is an enlarged sectional elevational view of the receptacle of FIGURE 1; and

FIGURE 3 is a more greatly enlarged sectional elevational detail view taken substantially along the line III—III of FIGURE 2.

As shown on the drawings:

In FIGURES 1 and 2, there is shown a receptacle or

cup indicated generally by the reference numeral **10**. Actually, the cup **10** has the general shape of a flower pot and, although it will be appreciated that a number of other receptacle shapes may be employed in the practice of the instant invention, it will be appreciated that the cup **10** has certain advantageous structural features. For example, an outwardly turned flange or lip **11** is formed along the top periphery of the cup **10** and an annular ridge **12** is formed in the upstanding cup walls W intermediate the bottom **13** and the top lip **11**. The top lip **11** and the intermediate ridge **12** give added strength to the cup **10** and facilitate the manual handling thereof.

As will be seen from FIGURE 2, the walls W of the cup **10** are tapered generally from the top lip **11** to the reduced diameter of the bottom **13**. Actually there is an upper wall portion W–**1** which tapers inwardly from the top lip **11** to the ridge **12**, whereat the diameter of the walls W is reduced; and the lower wall portion W–**2** also tapers inwardly from the annular ridge **12** to the bottom **13**.

As indicated in FIGURE 3, the cup **10** is formed of a highly vesiculated lightweight mass of polystyrene (indicated in section) composed of numerous closed cells C (indicated as circles in FIGURE 3).

In general, the cup **10** is formed by initially extruding foamed polystyrene into a flat sheet of substantially uniform thickness in the range of 0.020 to 0.070 inch, followed by hot-drawing this flat sheet into the instant cup between suitable dies which are heated at a temperature (of about 150° C.) sufficient to effect deformation of the flat sheet. The deformation effected is permanent, because the material is heated to its deformation temperature between the dies. This requires the application of pressure, of course, in order to effect such deformation, but the small cells C which may be crushed or eliminated during the hot pressing operation tend to appear substantially entirely as they were in the original flat sheet as soon as the pressure is removed. The pressure is removed while the material is still hot. In this way the cellular character of the material is not lost during this subsequent forming step. The advantages of lightweight and heat insulation are retained, while the additional advantages of strength in the receptacle-shaped device are gained. The inherent resilience in the material is retained to a desirable extent.

The resulting cup is unique in a number of respects. In appearance, it has a generally fibrous character, which is due to the extrusion forming operation of the initial flat sheet, but which is not lost by the subsequent hot-deformation. In effect, the hot-deformation subtracts nothing from the original advantageous features of the flat sheet, but adds the desired structure of the receptacle. The instant receptacle is unique in that it can be held in the hand while very hot water is poured into the receptacle, and the insulating effect is so good that one is barely able to feel a slight warming of the outside walls of the cup when hot water is poured into the cup.

In the practice of the instant invention the initially formed flat sheet is preferably formed by extrusion through a circular orifice followed by slitting of the resulting tubular material so as to form the flat sheet. The extrusion is preferably carried out by a so-called "blow" extrusion process. The general features of this type of procedure are shown in the aforementioned McIntire U.S. Patent No. 2,450,436. In a continuous operation, of course, the materials are fed into one end of the extruder with a suitable gas generating material, which may be in the form of a material which is normally a gas or it may be in the form of a material which decomposes at the temperature which the material reaches just before departing from the extruder. If the mate-

rial is normally a gas such as methyl chloride, it may be fed into the extruder under the necessary pressure, as in the case of any volatile gas; and such gas thus fed into the material functions as a propellant for the extruder as well as the cell-forming material within the mass. Methyl chloride is superior because it is soluble in the polystyrene.

Polystyrene is inherently a poor conductor of heat, so the material is heated in the extruder to effect a sufficient softening thereof and the dissolving of the methyl chloride therein effects the formation of a gel, which is extruded from the machine. The extrusion thereof releases the pressure on the polystyrene mass thus permitting the methyl chloride (or other gas-forming material) retained or dissolved therein to separate from the viscous solid mass and form numerous small gas cells. The formation of the gas requires heat of vaporization which effects cooling of the polystyrene (which could not be cooled easily in other ways because of the poor heat conductivity).

For example, the polystyrene material which may be formed by carrying out the instant process may have a specific gravity as low as 0.04. Sheets of such material are available commercially in thicknesses ranging from 0.020 inch to 0.070 inch (and specific gravity of 0.04), and such sheets may be hot-formed into a receptacle such as the cup **10**.

As a specific example, a sheet of foamed polystyrene having a thickness of 0.030 inch and a specific gravity of 0.04 is laid over a positive mold member having the general shape of the interior of the cup **10**, and a negative mold member is pressed down over the sheet at 15 p.s.i. gauge pressure, while the sheet is heated to 150° C. The mold is opened while the sheet is still hot. The resulting cup **10** is found to have excellent strength

and resilience. It has retained its original specific gravity of 0.04 and its grease-proof and water-proof properties. It is also a heat insulator whose thermal conductivity k (in B.t.u./square foot/hour/° F. per foot) is found to be in the order of 0.25.

Comparable results are obtained using the same operating conditions on a sheet of extruded polystyrene having a thickness of 0.05 inch.

It will be understood that modifications and variations may be effected without departing from the spirit and scope of the novel concepts of the present invention.

We claim as our invention:

A cup consisting of a seamless integral piece of highly vesiculated polystyrene having closed cells therein; said cup having continuous side, base, and corner wall portions of uniform thickness throughout; said thickness being in the range of from 0.020 to 0.070 inch; and said polystyrene having a specific gravity on the order of 0.04; the highly vesiculated character of the polystyrene being uniform throughout the said side, base, and corner wall portions of said cup.

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