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D. W. DONOVAN ET AL

3,485,434

TRAY STRUCTURE

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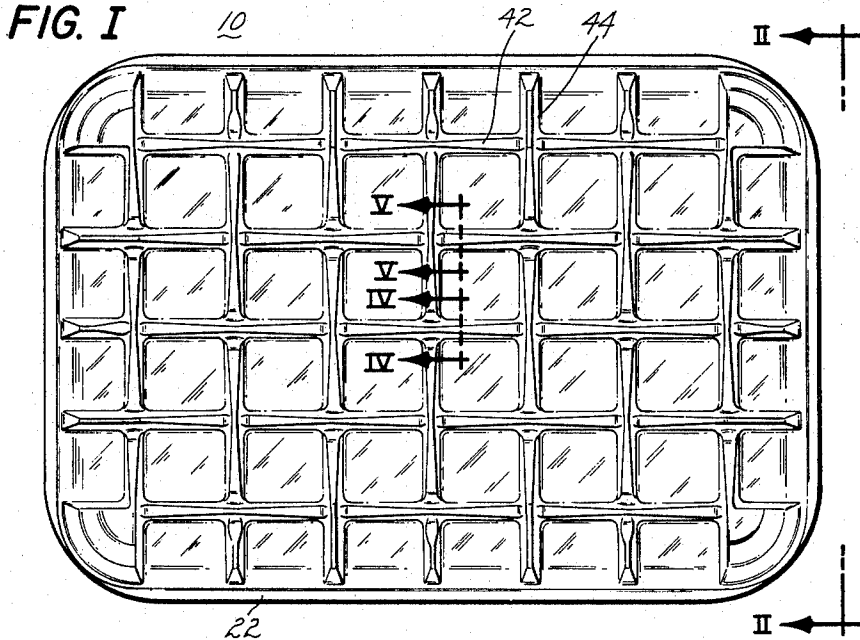


FIG. II



FIG. III

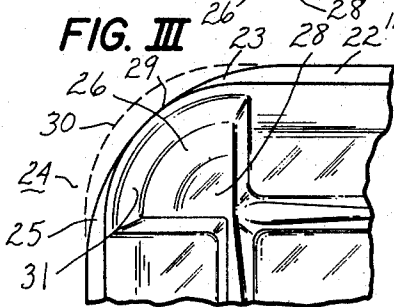


FIG. IV

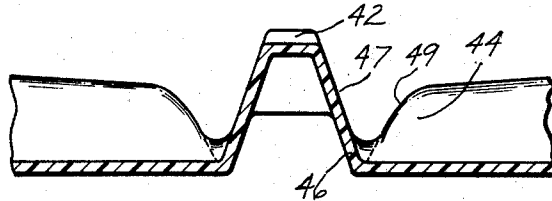


FIG. V

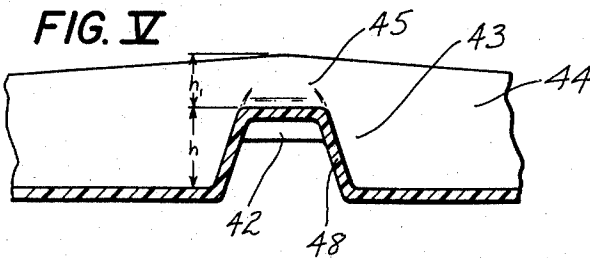
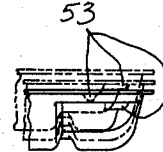


FIG. VI



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TRAY STRUCTURE

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10 Claims

ABSTRACT OF THE DISCLOSURE

Structural improvements in plastic trays provided by a rounded corner having a flange of minimum width which is less than that in the remainder of the tray, stacking provisions in the surface of the tray body, and a weaved intersecting rib pattern in the base of the tray, having a special type of interrupted configuration of the ribs at selective points in the pattern.

This invention is directed to a tray, and more particularly to structural improvements in a plastic tray.

The use of trays in merchandising consumer items is well-known. In recent years, overwrapped plastic trays have been used for holding foodstuffs such as candy, meat, poultry, fish, fruit, vegetables, etc. This use has been limited, however, by the marginal durability of the trays, and by the cost of the materials used in their construction. It has been a continuously recurring problem to develop geometry for imparting rigidity to, and eliminating bend points in a tray formed from an initially flexible sheet of plastic material, while keeping at a minimum the amount of material used in the formation of the tray. On the other hand, excessive reduction in the material used in fabricating the tray generally resulted in a tray which was too weak, or was susceptible to bending. This is particularly true in the relatively long, narrow type trays when the tray is held along an edge, or when being overwrapped with film material. Anything but gentle handling during the packaging operation often resulted in splitting and tearing of the tray or overwrap material, particularly in the corner areas.

Structural limitations have been solved to a certain extent by the designs described in copending U.S. application Ser. Nos. 564,131, filed July 11, 1966, now Patent No. 3,403,834 and 684,417 filed Nov. 20, 1967, now Patent No. 3,420,431 both of which are owned by the assignee of the present application. Further improvements have since been developed, however, which enhance to an even greater extent the packageability, structural stability, stackability and bend resistance of trays in general.

Accordingly, it is an object of this invention to provide a tray which avoids the prior art deficiencies discussed above.

It is an additional object of this invention to provide structural improvement in a plastic tray.

It is another object of this invention to provide a thermoplastic tray strong enough to contain relatively heavy items, yet able to withstand rather severe handling conditions particularly in the corner areas, while at the same time employing a minimum of material for its construction.

It is another object of this invention to provide a relatively long and narrow size thermoformed, plastic tray having improved resistance to bending, particularly when the tray is held along one edge while supporting a comparatively heavy item.

It is a further object of this invention to provide a tray having a surface configuration such that a plurality of like trays may be stacked in telescopic relationship without wedging together.

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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 one piece, thin wall, seamless plastic tray comprising a base, sides extending upwardly from the periphery of the base, a rounded corner at the intersection of two of said sides, and a flange extending outwardly in relation to and around the periphery of the sides, the flange at the rounded corner having a minimum outward projection which is less than that in the remainder of the tray. The tray may have stacking depressions in its surface close to its periphery. The tray may further comprise a plurality of substantially parallel upwardly projecting primary ribs integral with the base and extending across the base within the sides, and a plurality of substantially parallel upwardly projecting secondary ribs integral with the base and extending transversely with respect to the primary ribs within the sides, the secondary ribs having first portions which blend into substantial portions of the sides of the primary ribs, second portions which extend over the tops of the primary ribs, and third portions which blend into minor portions of the sides of the primary ribs, or terminate short of the sides of the primary ribs.

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

FIG. I is a plan view of a tray constructed in accordance with the present invention;

FIG. II is an elevational view along the line II—II of FIG. I;

FIG. III is a plan view of a corner of the tray of FIG. I;

FIG. IV is a side, sectional view of a rib portion, taken along the line IV—IV of FIG. I;

FIG. V is a side, sectional view of a portion of the ribs of FIG. IV, taken along the line V—V of FIG. I and

FIG. VI is a partial elevational view of a series of stacked trays.

With reference to the drawings wherein identical numerals refer to identical parts, there is shown in FIGS. I and II a one-piece, thin wall, seamless, shallow, plastic tray 10 comprising a bottom 12, a plurality of sides 14 and 16 extending upwardly and tapering slightly outwardly from the periphery of bottom 12, and a rounded corner 24 in the area of the junction of two of the sides. Tray 10 may be of generally rectangular shape, wherein sides 14 and 16 are opposed, and joined therebetween by a pair of opposed shorter sides or endwalls, one of which is typically shown as 18 in FIG. II, and which likewise extend upwardly and outwardly from the periphery of base 12. The shallowness of the tray, as used herein, is measured by the height of the tray sides, and may range between about 3/16 to 2 inches. Flange 22 projects outwardly in relation to the sides, and in FIGS. I and II it projects outwardly from the top of sides 14, 16 and 18 and generally extends around the periphery of the tray body.

As a feature of the present invention, there is shown in enlarged form in FIG. III a special corner 24, located in the circular segmental area of the junction of any two sides of the tray of FIG. I. Corner 24 is rounded, as shown, and comprises side 26 and bottom 28. Peripheral flange 22 is interrupted and substantially disappears at corner 24, by tapering smoothly at 23 and 25 into an area of minimum width, which is shown as a zero width in FIG. III, leaving only top edge 29 of side 26 along corner 24. Dotted line 30 represents the outline of flange 22 were it to have been included in corner 24. Corner 24 may also include interned reinforcing bend 31 between the top and bottom edges thereof for strengthening purposes.

Tray 10 may further comprise a plurality of primary

strengthening ribs 42, integral with, projecting upwardly from, and extending across bottom 12, within sides 14 and 16 in a direction generally parallel to sides 14 and 16, these sides being the longer of the four sides of generally rectangular tray 10. Also provided are a plurality of spaced secondary ribs 44, integral with, projecting upwardly from and extending across bottom 12 within the tray sides in a direction traverse with respect to the primary ribs, or generally perpendicular thereto. Ribs 44 intersect primary ribs 42, at right angles thereto, as shown in FIG. 1, and are generally parallel to ribs 18, a short side of the four sided rectangular tray 10.

As a particular feature of the present invention, the manner in which secondary ribs 44 intersect or approach intersection with primary ribs 42 provides additional strength to the tray particularly along long sides 14 and 16. As apparent from FIG. IV, secondary rib 44 is designed so that an extension of the top surface 49 of secondary rib 44, shown dotted in FIG. IV, terminates short of and does not extend into the lower portion 46 of side 47 of primary rib 42. Extension 49 tapers downwardly from top to bottom, adacent the primary rib. Primary rib 42, therefore, is essentially uninterrupted at this point, and free of intersection with rib 44. FIG. V, however, illustrates the side view of the same rib 44 wherein a first portion 43 blends into a substantial portion h of the side 48 of primary rib 42, and a second portion 45 identified as h_1 extends over the top of primary rib 42. The only planned design intersection, therefore, of the primary and secondary ribs 42 and 44 occurs in the manner depicted in FIG. V. This design may be likened to an integral weave formed in the base of the tray.

As an additional feature of the present invention, there are shown in FIG. VI provisions for maintaining a series of trays spaced from each other when in nested relationship. In each of the four corners of the trays depressions 53 are provided which project outwardly from the tray surface, with the outer surface of a depression designed to rest on an inner uninterrupted surface of an adjoining tray when a plurality of like trays are stacked within each other, so as to maintain a clearance between the surfaces of stacked trays. Depressions 53 of adjoining stacked trays must be nonaligned, as shown, i.e., are not located in the same spot in the tray surface, in order to insure that a depression of one tray contacts a smooth surface of an adjoining tray, as opposed to another depression.

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.

It should be noted that the tray structural improvements of the present invention, i.e., the rounded corner having a flange of minimum width, the integral intersecting strengthening ribs having a special interrupted design at particular points of intersection, and the stacking depressions may be used independently in a tray of any type construction, or in combination with each other in a tray of the configuration shown or in any other type tray. The minimum width corner, for example, may be unnecessary when a film overwrap is not used.

The minimum width corner of the present invention eliminates a tendency for cracking and splitting to occur in the corner area, when any degree of force is applied to a corner surface. For example, if a tray or a number of stacked trays are accidentally dropped on their corners either prior to the packaging operation while empty, or while holding the packaged product at the consumer level, the flexible plastic material of fabrication will bend inwardly at the peripheral extremities of the corner. Under this condition the plastic is put under tension at these points, with the result that any corner flange in use tends to crack in these areas of tension. Sharp edges are created at the crack, which in turn rip any thin covering such as an overwrap which may be in use on the package, and may even cut the fingers of the purchaser. If it is desired to heat seal a panel across the top the seal in the cracked

area will be discontinuous. Such a rip in an overwrap or heat sealed panel destroys the package seal, and exposes the contents to the environments, with the result that the product may deteriorate rapidly. Elimination of, or provision of a minimum flange in the corner area avoids or minimizes these bend points and provides a sturdy tray corner design, since no particular section of the corner is put under any greater stress than any other section during any severe handling conditions.

The flange width in the corner area is preferably the minimum that may be practically obtained with known forming methods. In general, this minimum may range from 0 to 0.80 and preferably 0 to 0.25 times the minimum width of the peripheral flange in the remainder of the tray body.

The corner design of the present invention must be rounded in order to avoid tearing a film overwrap applied around the tray. Rounded corners also permit improved delineation of the contour during the molding process over that obtainable in molding a sharp corner. Sharp edged corners also provide bend points for the flexible plastic of the tray which tend to crack during handling. In general, the radius of curvature of the rounded corners of the present invention range between about $\frac{1}{16}$ to $1\frac{1}{2}$ inches, and preferably between $\frac{1}{8}$ to 1 inch.

Though it is preferred to have a minimum or zero flange width in the corners of the tray of the present invention, the tray is nevertheless preferably provided with a peripheral flange projecting outwardly in relation to the top of the sides around the remainder of the tray periphery, other than in the corners. Such a projecting flange acts as a bend resistant support leg for its side, and is particularly advantageous in high speed packaging operations, where reciprocating fingers in automatic destacking equipment must engage the nested trays between their flanges to separate the bottom tray from its stacked position. The sidewall flange width may range between about $\frac{1}{16}$ " to $\frac{1}{2}$ " and preferably between about $\frac{1}{8}$ " to $\frac{1}{4}$ ".

The spaced stacking depressions in the tray surface are important and are consistent with the desire to adapt the tray of the present invention to high speed packaging operations. The depressions must project outwardly of the tray surface, and be non-aligned in adjoining trays in a stack. There may be any number of such depressions utilized, but at least three are required to maintain a balanced condition with most tray designs. The depressions may be located anywhere in the tray surface, but are preferably situated close to the periphery, for example, in the outer $\frac{2}{3}$ of the tray base surface, and in the tray corners in non-circular designs. Depressions in strengthening rib surfaces generally tend to weaken the ribs and, therefore, are not desirable. Provision of a space between adjoining stacked trays facilitates use of automatic destacking equipment with the trays, in that reciprocating pickoff fingers may easily move into the stacking space between trays to disengage the bottom or top tray of a stack in a filling line.

Although the illustrated embodiment is a tray of generally rectangular shape, and this is preferred for storage economy purposes, it is obvious that the tray may be of other various shapes, e.g., square, oval, triangular, round and the like.

The selectively interrupted rib weave design of the present invention provides a greater area of undisturbed rib along one side of the tray, and, therefore, enhanced resistance to bending in this direction, i.e., the direction perpendicular to that of the uninterrupted rib. The intersection or tie in of a primary rib with a secondary rib tends to decrease the strength of the primary rib because of the joint, and this effect is minimized with the present design. On the other hand, the elimination of a tie in or joint of a secondary rib with a primary rib tends to decrease the strength to resist bending in the opposite direction, i.e., the direction perpendicular to that of the interrupted rib, since the tie in of the secondary rib is

eliminated. But this latter decrease in bend resistance is not as important when the tray is of a generally rectangular configuration and the primary ribs run generally parallel to the long side, since the tendency is for the consumer to hold the tray containing the packaged product along the short side whereupon the tendency of the tray to bend in a direction perpendicular to the long side is maximized, as opposed to a direction generally parallel to the long side, which is the less frequent situation occurring when the tray is held along the long side. Though this interrupted design is preferably used with trays of generally rectangular shape, e.g., square, oblong, it is obvious that it may likewise be employed with other shapes.

The extent of elimination of the tie in of a secondary rib to a primary rib at alternate points of approach of the secondary ribs to the primary ribs, may be limited by the forming method utilized. Thus, in the preferred thermoforming method to be hereinafter described, it may not be possible to completely draw the plastic material into the mold so as to accurately define the end portion of a secondary rib adjacent to the wall of the primary rib, without terminating the secondary rib considerably short of the wall of the primary rib, thereby excessively weakening the strength provided by the secondary ribs. A partial joint having a slight filling of plastic in the crevice between the side of the primary rib and the end of the secondary rib may, therefore occur as shown in FIG. II. This, of course, need not happen if the tray is injection molded, wherein plastic drawing does not occur and the secondary rib portion may be fully terminated short of—yet close to—the side of the primary rib. In general, the height of the third portion of a secondary rib in the area of the interrupted design as shown in FIG. II should be between 0 to 0.09 and preferably between 0 to 0.05 times the height of the primary rib at this interrupted joint, and most preferably an extension of the surface of the secondary rib at this joint should approximately intersect the base of the primary rib as depicted in FIG. II. In this way the joint does not interfere with the major support provided by the primary rib at these points in the tray. The height of first portions of the secondary ribs which desirably intersect a substantial portion of the side of a primary rib at alternate areas of approach of the secondary ribs to the primary ribs is between about 0.1 to 0.9 times the height of a primary rib side at its intersection with the first primary rib portion.

The special bend resistant pattern herein described may, of course, be utilized in any tray size, but is especially applicable to relatively long and narrow trays wherein the uninterrupted ribs are generally parallel to the long side and have base cross sectional areas between about 4 to 200 square inches.

The material from which the tray is formed may be any thermoplastic material capable of being molded in accordance with the previously mentioned design parameters. Thermoplastic materials generally have the advantages of being tough, difficult to break under ordinary circumstances, non-porous to juices and various extracts and have sufficient strength to be fabricated relatively thinly for economy purposes, since the containers contemplated herein are of the throw-away, non-reusable type. The forming method may be by injection molding, though the preferred method is from web stock by any of the well-known sheet thermo-forming processes such as, for example, pressure differential forming, using vacuum or positive pressure. The resulting tray when formed in this manner is unitary in construction, has no seams and is of the thin wall variety having a generally uniform wall thickness between about 2 to 80 mils. The various ribs when formed integrally in the tray body in this manner are well defined and sturdy yet hollow, thereby conserving material used in the construction. Usable thermoplastics are polyolefins, such as for example, poly-

ethylene or isotactic polypropylene; polyacrylates, polymethacrylates; polycarbonates, polymethacrylates; polycarbonates; polyvinyl chloride, and polyethylene terephthalates. The preferred materials are styrene copolymers, for instance, styrene-acrylonitrile copolymers, and most particularly, is biaxially oriented polystyrene preferred, since even when thin this material is tough and resilient, even at low temperatures, and furthermore is generally inert to most foods such that there usually need be no concern that packaged meat, for example, will absorb flavor from the tray. The low temperature stability of styrene copolymers is important in considering the plastic to be used in fabricating the tray of the present invention, since it must be kept in mind that the contents at times may be refrigerated below about 0° F., for extended periods. Some plastics are more brittle and susceptible to fracture than styrene based polymers under these conditions.

When packaging meat products and the like, wherein full examination of the contents is desired by the purchaser, the thermoplastic used is preferably entirely transparent, including that of any covering applied across the top and sides of the supporting tray. Otherwise the tray may be of any desired color.

In the case of the preferred biaxially oriented polystyrene plastic material referred to above, the thermoforming operation is generally carried out at temperatures ranging anywhere from 175 to 400° F. utilizing differential pressures to form the sheet material against the wall of a die contoured to affect the design described previously.

In general, the present tray finds particular utility for the packaging of various consumer items such as candy, vegetables, etc., and particularly meat products. Structural stability is provided by a geometrical design which permits converting an initially flexible plastic sheet into a sturdy, bend resistant tray, utilizing a minimum of material for its construction, while minimizing the crack susceptible bend points in the body of the container. In most instances, an overwrap which may be of transparent plastic is employed with the tray of the present invention to protect the contained items from detrimental effects of exposure to the environments. Furthermore, the package is attractively symmetrical in appearance, and has unique adaptability to high speed forming and packaging operations.

The above description and particularly the drawings are set forth for purposes of illustration only. It will be understood that many variations and modifications of the embodiments herein described will be obvious to those skilled in the art, and may be carried out without departing from the spirit and scope of the invention.

What is claimed is:

1. A one-piece, thin wall, seamless resilient thermoplastic tray comprising:
 - (a) a base;
 - (b) sides extending upwardly from the periphery of the base;
 - (c) a rounded corner at the intersection of two of said sides;
 - (d) a flange extending around the periphery of the tray terminating between $\frac{1}{16}$ to $\frac{1}{2}$ inch outwardly of the upper edge of each side, said flange at said rounded corner having a minimum outward projection to minimize fracturing the thin wall thermoplastic in the corner area when the corner is deflected.
2. The tray of claim 1 wherein the outward projection of the flange along the rounded corner is between 0 to 0.80 times the minimum outward projection of the remainder of the tray flange.
3. The tray of claim 1 including at least three stacking depressions in the tray surface close to its outer periphery.
4. A one-piece, thin wall, seamless plastic tray comprising:
 - (A) a base;

- (B) sides extending upwardly and outwardly from the periphery of the base;
- (C) a plurality of substantially parallel upwardly projecting primary ribs integral with the base and extending across the base within the sides; and
- (D) a plurality of substantially parallel upwardly projecting secondary ribs integral with the base and extending across said base within the sides in a direction different from that of the primary ribs
- (a) said secondary ribs having first portions which blend into substantial portions of the sides of said primary ribs, second portions which extend over the tops of said primary ribs, and third portions which blend into minor portions of the sides of said primary ribs.
5. The tray of claim 4 wherein the height of a first secondary rib portion which blends into a substantial portion of the side of a primary rib is between 0.1 to 0.9 times the height of the primary rib at the intersection with said first secondary rib portion, and the height of a third secondary rib portion which blends into a minor portion of the side of a primary rib portion is between 0 to 0.09 times the height of the primary rib at the intersection with said third secondary rib portion.
6. The tray of claim 4 wherein the third portions of the secondary ribs terminate short of the sides of the primary ribs.
7. The tray of claim 4 wherein the ends of the third portions of said secondary ribs taper outwardly from top to bottom.
8. A one-piece, thin wall, seamless plastic tray comprising:
- (A) a base;
- (B) sides extending upwardly and outwardly from the periphery of the base;
- (C) a plurality of substantially parallel upwardly projecting primary ribs integral with the base and extending across the base within the sides; and
- (D) a plurality of substantially parallel upwardly projecting secondary ribs integral with the base and extending across said base within the sides in a direction different from that of the primary ribs
- (a) said secondary ribs having first portions which blend into substantial portions of the sides of said primary ribs, second portions which extend over the tops of said primary ribs, and third portions which terminate short of the sides of said primary ribs.
9. A transparent, thin wall, seamless plastic tray of biaxially oriented polystyrene comprising:

- (A) a base;
- (B) sides extending upwardly and outwardly from the periphery of the base;
- (C) a rounded corner at the intersection of two of said sides;
- (D) a flange extending outwardly around the periphery at the tops of the sides, said flange at said rounded corner having a minimum outward projection;
- (E) a plurality of substantially parallel upwardly projecting primary ribs integral with the base and extending across the base within the sides; and
- (F) a plurality of substantially parallel upwardly projecting secondary ribs integral with the base and extending across said base within the sides in a direction substantially perpendicular to that of the primary ribs
- (a) said secondary ribs having first portions which blend into substantial portions of the sides of said primary ribs, second portions which extend over the tops of said primary ribs, and third portions which blend into minor portions of the sides of said primary ribs.
10. A plurality of similarly configured nested, one-piece, thin wall, seamless plastic trays forming a stack, each of said trays comprising a base, sides extending upwardly and outwardly from the periphery of the base, a projecting portion extending outwardly around the periphery of the tray from the upper edges of the side and at least three stacking depressions spaced from each other in the tray surface, said depressions in immediately adjacent trays within the stack being vertically misaligned, whereby the surfaces of the depressions in one of said trays rest on a surface of the next lower tray within the stack thereby providing a clearance between the projecting portions of immediately adjacent trays within the stack, said clearance being substantially defined by the depth of the depressions in the trays.

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