June 27, 1967 D. J. ASENBAUER 3,327,896

STACKABLE CONTAINER

Filed June 4, 1965 5 Sheets-Sheet 1

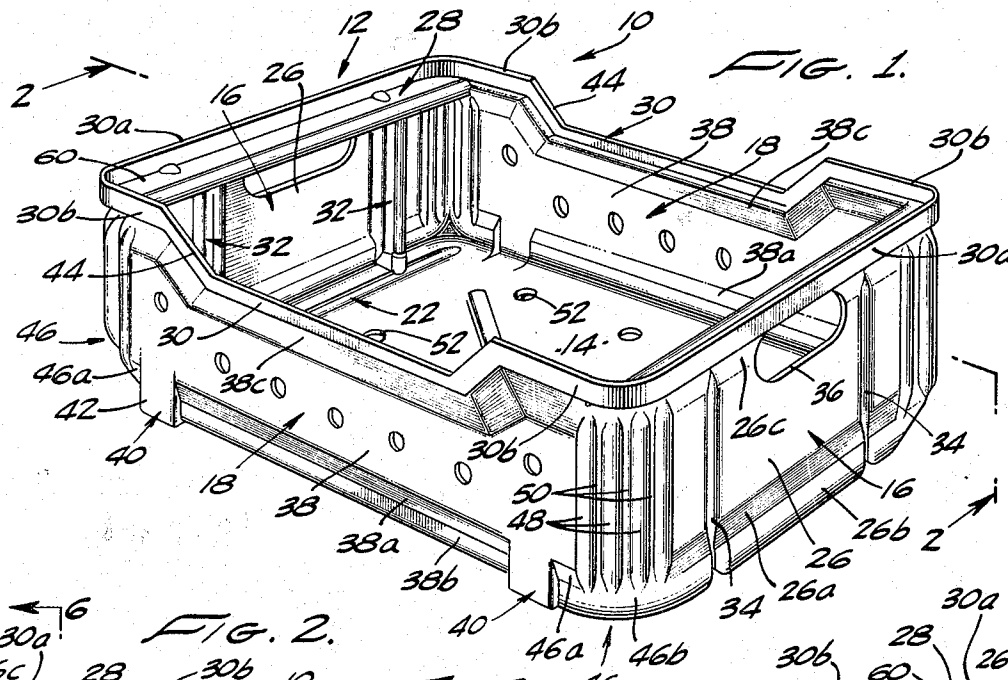


FIG. 1.

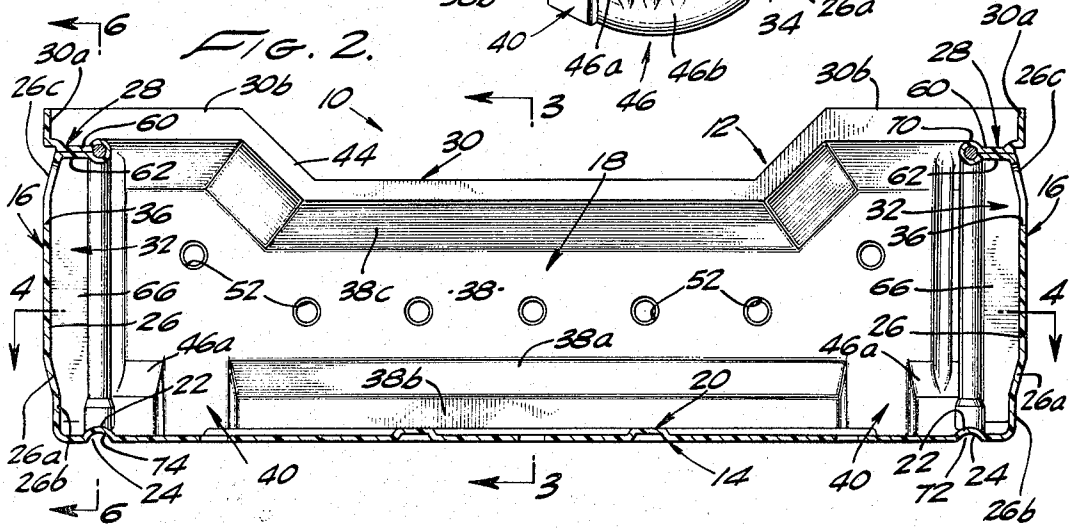


FIG. 2.

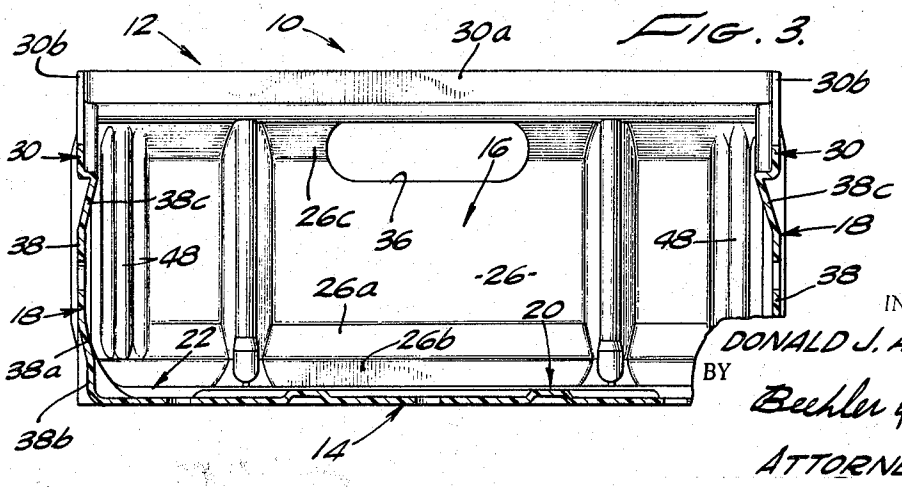


FIG. 3.

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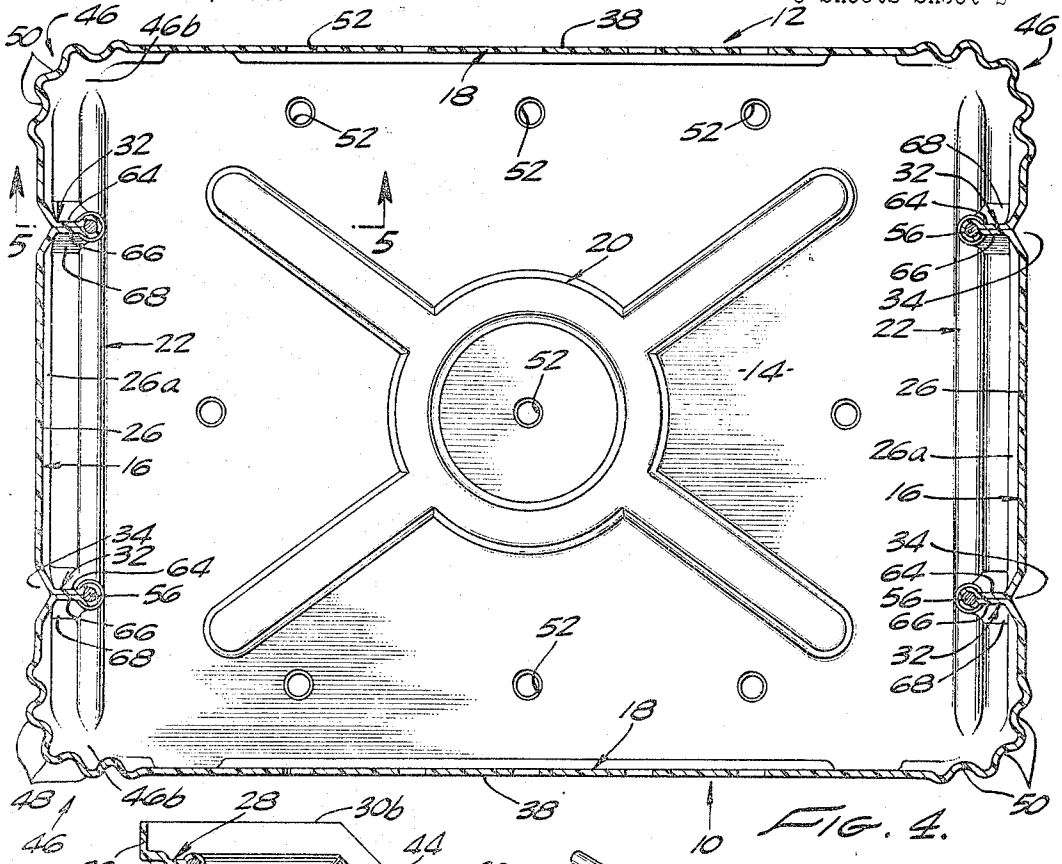


FIG. 4.

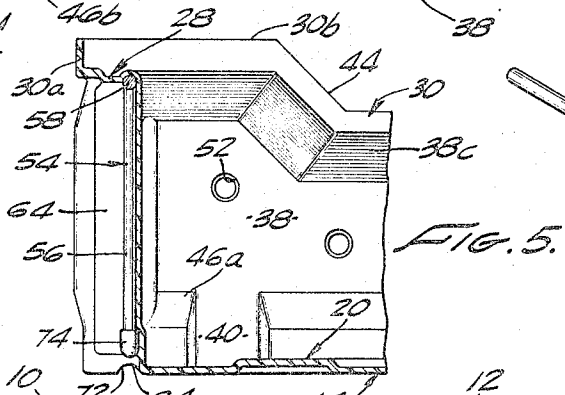


FIG. 5.

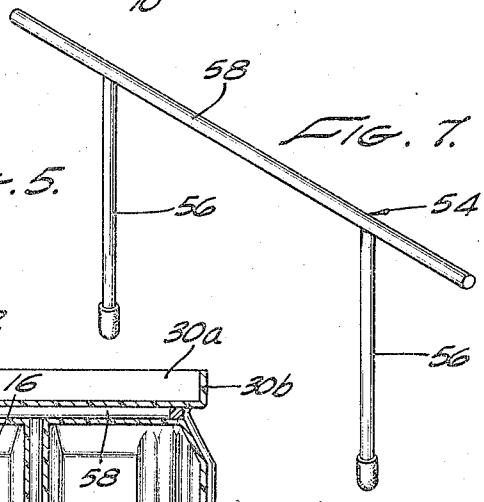


FIG. 7.

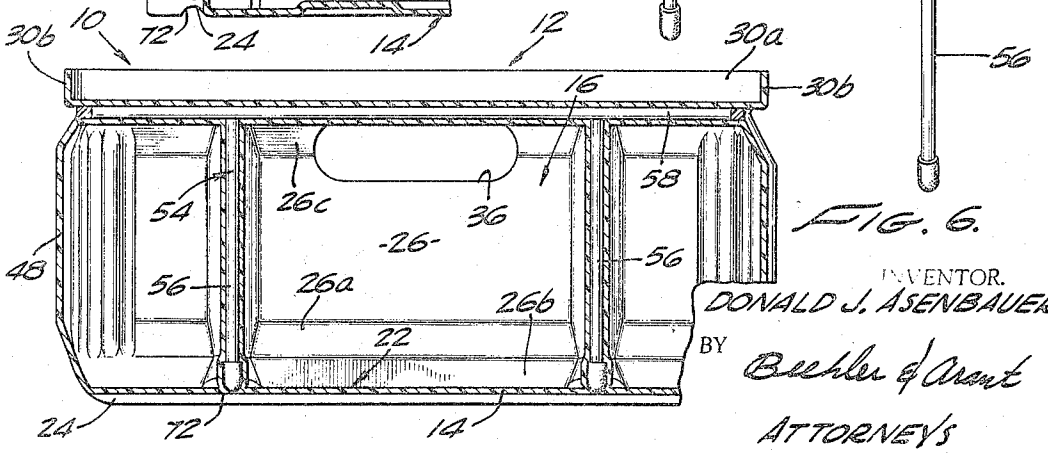


FIG. 6.

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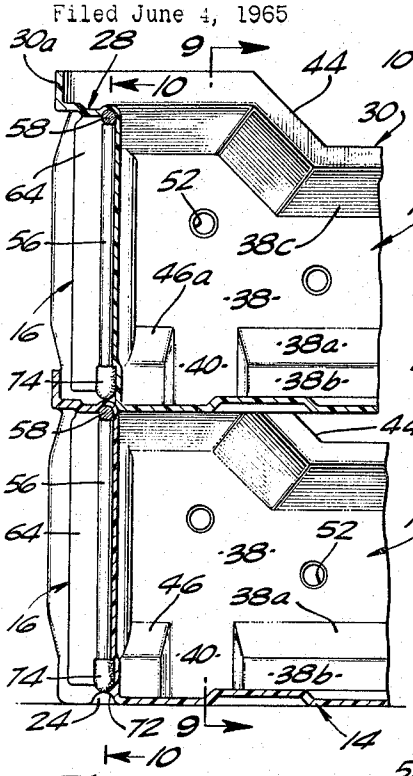


FIG. 8.

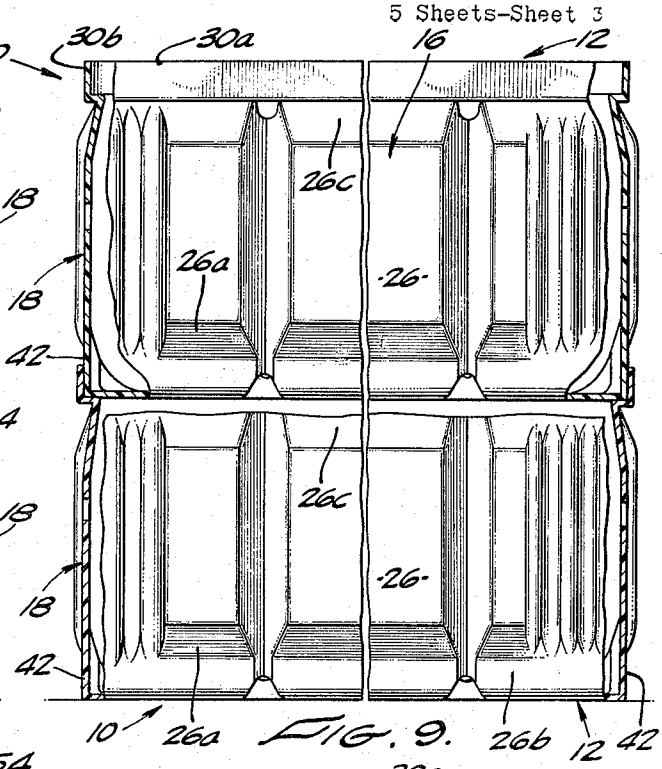


FIG. 9.

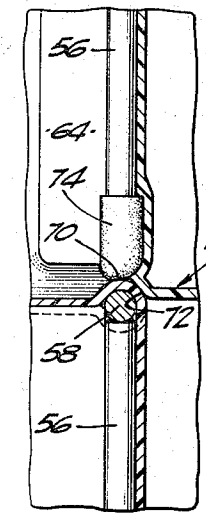


FIG. 11.

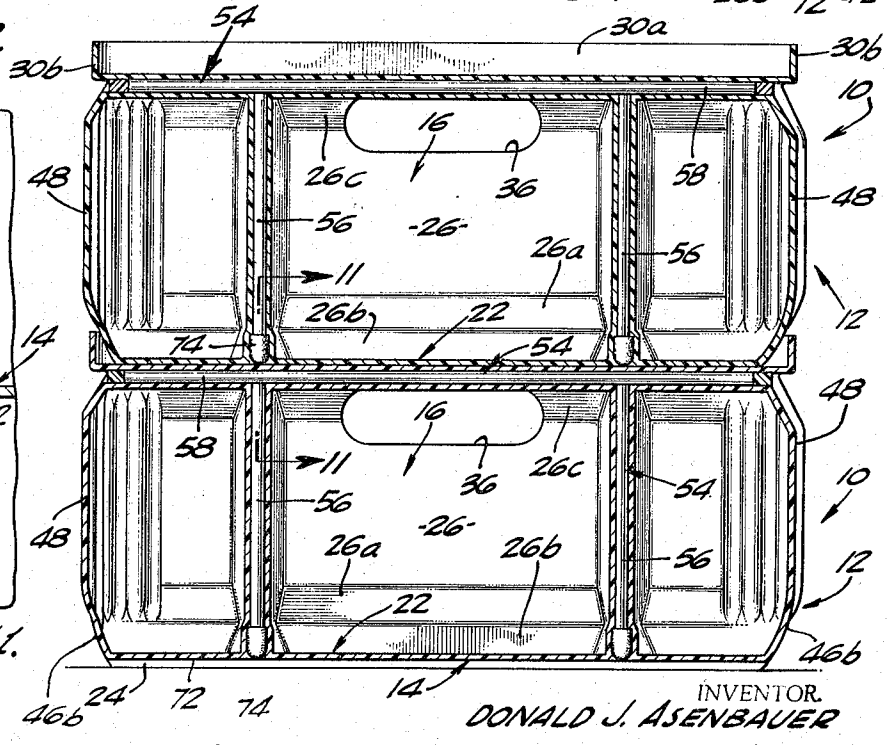


FIG. 10.

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STACKABLE CONTAINER

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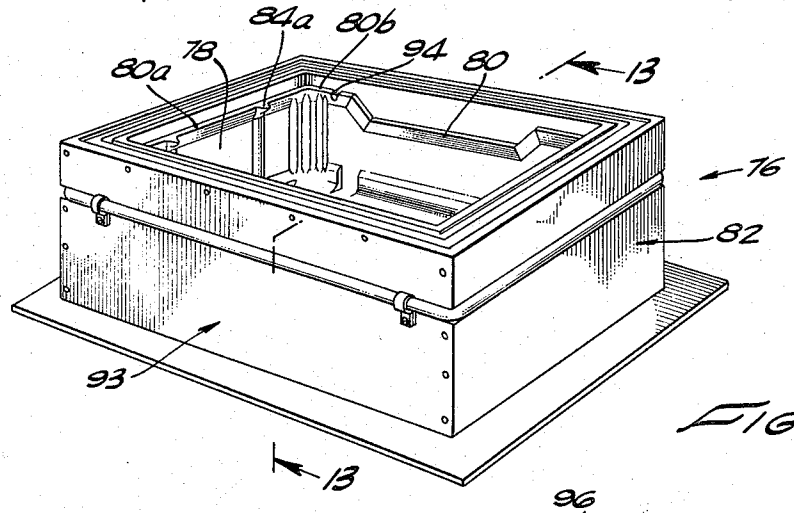


FIG. 12.

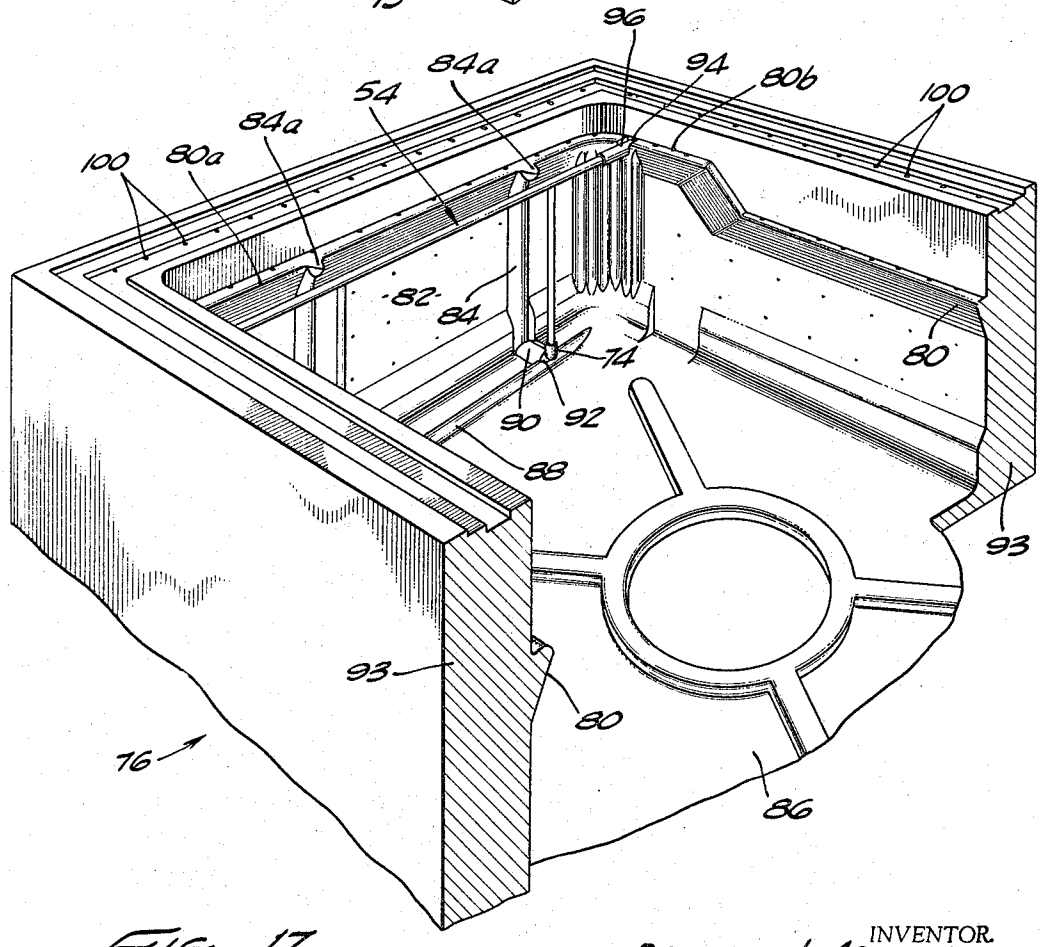


FIG. 17.

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STACKABLE CONTAINER

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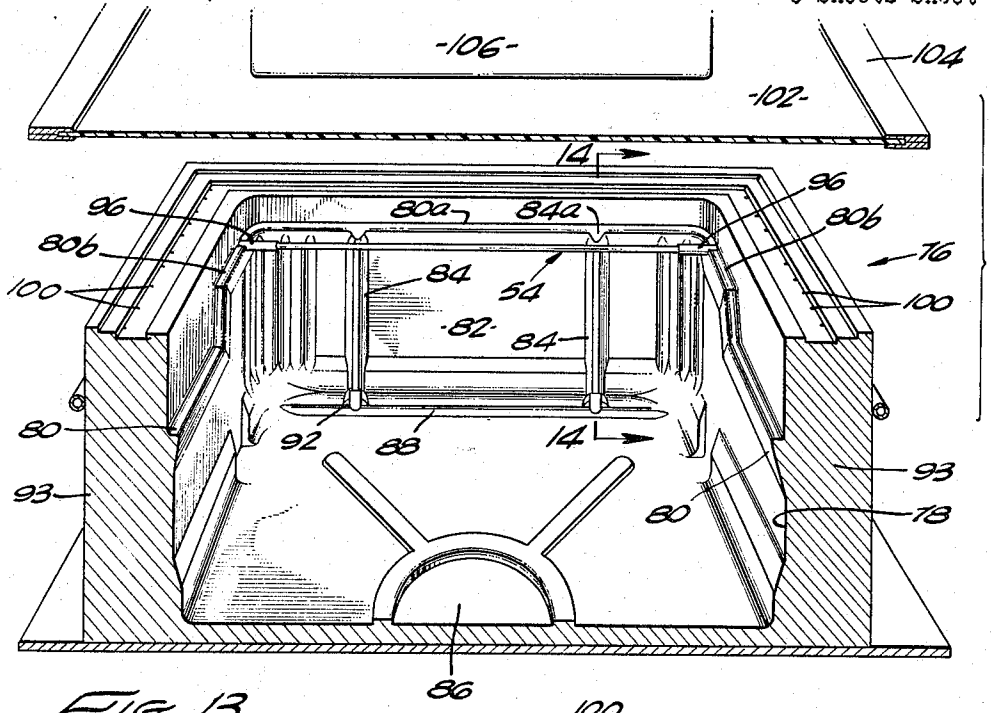


FIG. 13.

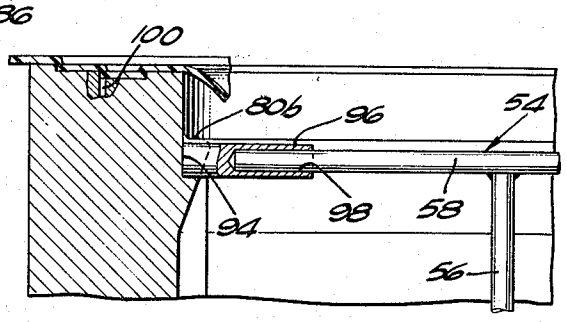


FIG. 15.

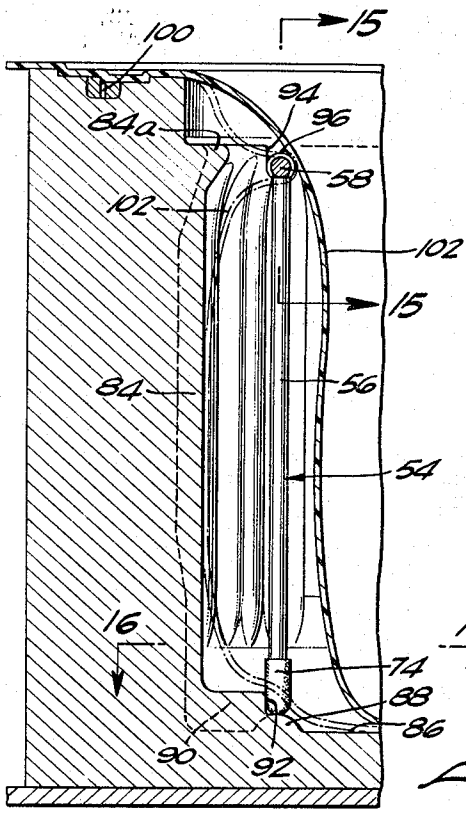


FIG. 14.

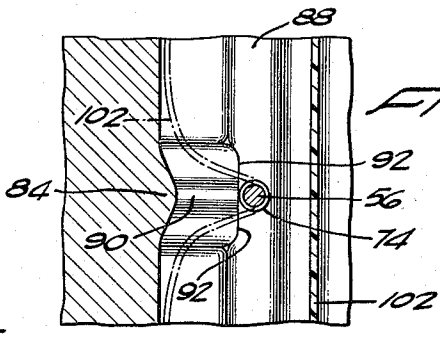


FIG. 16.

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United States Patent Office 3,327,896 Patented June 27, 1967

3,327,896

STACKABLE CONTAINER

Donald J. Asenbauer, Whittier, Calif., assignor to Shell Oil Company, New York, N.Y., a corporation of Delaware

Filed June 4, 1965, Ser. No. 461,313
14 Claims. (Cl. 220—97)

This invention relates generally to containers of the type which are adapted to be stacked one on top of the other during storage and shipment. The invention has more particular reference to an improved stacking container of this type embodying novel vertical load-bearing reinforcing means and to a novel method of and apparatus for fabricating the container.

Most containers for handling and shipping articles of commerce are designed to be stacked one on top of the other during storage and shipment in order to permit optimum utilization of the available storage and shipping space. When filled containers are stacked in this way, there is imposed on each container a vertical load equal to the combined weight of the overlying containers and their contents. The bottom container in the stack, of course, is subjected to the maximum vertical load. Since any container may be placed at the bottom of such a stack, each container must be designed to support the maximum load imposed on the bottom container when the containers are stacked to their limiting height.

Some containers, such as carboard containers for canned goods and the like, are so designed that vertical stacking loads imposed on the containers are carried by the container contents. In this case, the containers themselves support little if any of the vertical load and thus may be constructed of relatively light weight material, sufficient in strength merely to confine the container contents during handling and storage. Other containers, on the other hand, such as produce containers, or produce trays as they are commonly referred to, must be capable of supporting the entire vertical load imposed thereon when stacked. It is this latter type of stacking container with which the present invention is concerned.

Generally speaking, a stacking container of the type last referred to above may be constructed in either of two ways. Thus, the main body of the container may be fabricated from a material which possesses sufficient strength to support the vertical loads imposed thereon when the container is stacked with other containers. Containers of this type, however, tend to be quite heavy, costly, and otherwise deficient. Alternatively, the main body of the container may be fabricated from a relatively lightweight or low strength material such as molded plastic, and auxiliary load-bearing reinforcing means may be incorporated in the container to provide the latter with the requisite stacking strength. This invention is particularly concerned with such reinforced stacking containers.

Accordingly, it is a general object of the invention to provide an improved reinforced stacking container as well as a novel method of and apparatus for fabricating the container.

A more specific object of the invention is to provide a reinforced stacking container equipped with novel vertical load-bearing reinforcing means which are arranged to carry substantially the entire vertical stacking load imposed on the container when the latter is stacked with other like containers and to transmit this stacking load directly to the load-bearing reinforcing means of the adjacent lower container in the container stack.

A related object of the invention is to provide a reinforced stacking container wherein the load-bearing reinforcing means comprises vertical reinforcing rods, and wherein further the container is equipped with complementary upper and lower nesting formations which are

adapted for nesting interengagement with the lower and upper nesting formations, respectively, on adjacent containers in a container stack in such manner as to maintain the corresponding reinforcing rods or adjacent containers in coaxial alignment, particularly under load.

Yet another object of the invention is to provide a reinforced stacking container comprising a main, one-piece molded plastic body, and wherein the load-bearing reinforcing means of the container comprise metal reinforcing frames which are incapsulated within the plastic sidewalls of the body in such manner that the frames and their incapsulating sidewalls mutually reinforce one another and said frames are shielded against corrosion.

A related object of the invention is to provide a novel vacuum forming method and die for making a reinforced molded plastic container according to the preceding object.

A further object of the invention is to provide a reinforced stacking container which is constructed for frictional nesting engagement with other light containers, when empty, in such a way that the empty containers are frictionally restrained against separation under the action of road-shock encountered during shipment.

Still a further object of the invention is to provide a reinforced stacking container which is relatively simple in construction, economical to fabricate, light-weight and yet rugged and durable, and otherwise ideally suited to its intended purposes.

Other objects, advantages, and features of the invention will become readily evident as the description proceeds.

With these and other objects in view, the invention consists in the constrution, arrangement and combination of the various parts of the present container and container-forming die, as well as the combination of the various method steps involved in the fabrication of the container, whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In these drawings:

FIGURE 1 is a perspective view of a stacking container according to the invention;

FIGURE 2 is an enlarged section taken on line 2—2 of FIGURE 1;

FIGURE 3 is a section taken on line 3—3 of FIGURE 2;

FIGURE 4 is a section taken on line 4—4 of FIGURE 2;

FIGURE 5 is a section taken on line 5—5 of FIGURE 4;

FIGURE 6 is an enlarged section taken on line 6—6 in FIGURE 2;

FIGURE 7 is a perspective view of a metal reinforcing frame embodied in the container;

FIGURE 8 is a fragmentary vertical section taken through two stacking containers of the type illustrated in FIGURES 1 through 6;

FIGURE 9 is a view looking in the direction of the arrows on line 9—9 in FIGURE 8, with parts broken away for clarity;

FIGURE 10 is an enlarged section taken on the line 10—10 in FIGURE 8;

FIGURE 11 is an enlarged section taken on line 11—11 in FIGURE 10;

FIGURE 12 is a perspective view of a vacuum forming die which is used in the present vacuum forming method of fabricating the container illustrated in FIGURES 1 through 11;

FIGURE 13 is an enlarged section taken on line 13—13 of FIGURE 12 illustrating the die in perspective and showing a plastic sheet about to vacuumed formed in an initial position over the die cavity;

FIGURE 14 is an enlarged section taken on line 14—14 in FIGURE 13 and illustrating the plastic sheet of FIGURE 13 in a partially vacuum formed position within the die cavity;

FIGURE 15 is a section taken on line 15—15 in FIGURE 14;

FIGURE 16 is a section taken on line 16—16 in FIGURE 14; and

FIGURE 17 is an enlarged fragmentary perspective view of the die cavity.

The stacking container 10 of the invention which has been chosen for illustration in these drawings is intended primarily for use as a produce tray for containing tomatoes or other similar agricultural products. It will become evident as the description proceeds, however, that the illustrated container may be used for other purposes and that the principal features of the invention may be employed in containers of other configurations than that illustrated. As will appear later, the illustrated container is constructed of a plastic material, such as plastic and is fabricated by a novel vacuum forming process or method.

With this preliminary discussion in mind, the illustrated stacking container 10 will be observed to comprise an integral body 12 including a bottom, generally rectangular wall 14 bounded by a first pair of generally parallel upstanding side walls 16 and a second pair of generally parallel upstanding sidewalls 18. Bottom wall 14 is generally flat and has a central upstanding rib formation 20 embossed therein from its underside to reinforce the wall. Adjacent the side walls 18 the bottom wall has a pair of upstanding, linear rib formations 22 which generally parallel the latter side walls. These latter rib formations have a generally circular curvature in transverse cross section and define channels or grooves 24 in the under side of the bottom wall.

The container side walls 18 include panels 26 which are generally disposed in planes normal to the bottom wall 14. Adjacent their lower edges the panels 26 slope inwardly at 26A and then continue in lower edge portions 26B which are generally normal to and merge with the bottom wall 14. The junctures of the bottom wall 14 and side wall panels 26 define lower, arcuate edges 27 of relatively small radius. Adjacent their upper edges, the side wall panels 26 slope inwardly at 26C to join horizontal stacking shelves or ledges 28. These stacking ledges extend lengthwise along the upper edges of the side wall panels 26, from one side wall 18 to the other, and extend laterally inward from the panels in a common plane parallel to the bottom wall 14. Rising above the stacking ledges 28 is a rim or flange 30 which continues along the upper edges of the side walls 18 so as to completely encircle the upper, open top of the container. Projecting inwardly from each side wall panel 26 are a pair of vertical reinforcing ribs 32. These ribs extend between and are joined to the bottom wall 14 and the adjacent stacking ledge 28. The ribs are located about midway between the center and the ends of the stacking ledges. The outer surfaces of the panel 26 have vertical grooves or channels 34 in line with these ribs. Opening centrally through the panels 26, just below the stacking ledges 28, are handholds 36.

Side walls 18 of the container 10 comprise panels 38 which are generally disposed in planes normal to the bottom wall 14. Adjacent opposite ends of each side wall panel 38 are a pair of generally rectangular, leg-like formations 40. The outer surfaces 42 of these formations are located in the same plane as the outer surface of the respective side wall panel 38. The lower surfaces of the formations 40 are located in the same plane as the under surface of the bottom wall 14. Each side wall panel 38, in the region between the adjacent formations 40, slopes inwardly at 38A and then continues in the lower, arcuate edge portion 38B which merges generally tangentially with the bottom wall 14. Adjacent its upper edge, each

side wall panel 38 slopes inwardly at 38C and then extends laterally outward at 38D to join the lower edge of the container rim 30. In the region between their ends, the side wall panels 38 are reduced in vertical height. Accordingly, the container rim 30, which follows the upper edges of the panel 38, drops within these regions to a level below the remaining, co-planer portions of the rim, thereby to define, at the upper edge of each side wall 18, a recess 44.

The adjacent ends of the container side walls 16 and 18 are joined by generally rounded corners 46 on the container body 12. These corners have lower, inwardly sloping wall portions 46A which are generally horizontally aligned with the sloping wall portions 26A, 28A or the adjacent side walls 16, 18 and lower, rounded edge portions 46B which merge generally tangentially with the lower container wall 14. Each corner 46 has a series of externally raised, vertically elongated rib formations 48 and intervening, vertically elongated valleys 50. As shown best in FIGURE 4, the corner wall portions which define the rib formations 48 and valleys 50 have a generally semi-circular curvature in horizontal cross-section. The curved wall portions of the adjacent rib formations and valleys at each corner 46 merge generally tangentially in such a way as to define, in effect, a ninety-degree gear-like sector. These gear-like sectors form the subject matter of co-pending application Ser. No. 337,954, filed Jan. 15, 1964, and entitled, "Container Having Gear-Like Corners," and are provided to facilitate automatic handling of the container, as explained in the latter application. Since the present invention is not concerned with these gear-like sectors, no further description of the latter is deemed necessary.

As noted earlier, the illustrated container 10 is designed primarily for use in the agricultural industry for handling and shipping agricultural products, such as tomatoes, and is commonly referred to in such industry as a produce tray or a tomato tray. In accordance with the customary practice in that industry, the container, or tray 10 is provided with a number of ventilation openings 52.

Encapsulated within the container side walls 16 are metal, load-bearing reinforcing members 54. Referring to FIGURE 7, each reinforcing member 54 will be seen to comprise a frame-like structure including a pair of vertical, load-bearing reinforcing rods 56 and a horizontal, load-bearing reinforcing rod 58 which is welded or otherwise rigidly joined to the upper ends of the vertical rods 56. The vertical rods 56 extend vertically through the reinforcing ribs 32 on the container body 12, adjacent the vertical edges of these ribs. The horizontal rods 58 extend horizontally through the stacking ledges 28, adjacent the horizontal edges of these ledges. Referring to FIGURE 2, it will be observed that the stacking ledges 28 comprise upper and lower walls 60 and 62 which extend inwardly toward and finally around the horizontal reinforcing rods 58 of the respective reinforcing members 54. These walls merge and are integrally joined about the rod, as shown. The upper ledge walls 60 are integrally joined along their outer and end edges to the lower edge of the container rim 30. The lower ledge walls 62 are integrally joined along their outer edges to the upper edges of the side wall panels 26, respectively, and along their end edges to the curved wall portions of the adjacent container corners 46. In the regions between the side wall panels 26 and the reinforcing members 54, the walls 60, 62 of the stacking ledges 28 have contacting, confronting surfaces which extend through the outer sides of the container side walls 16 to join the outer surfaces of the side wall panels 26 and the container rim 30, respectively. As will appear later, these confronting surfaces of the ledge walls may be bounded to one another.

Referring to FIGURE 4, it will be observed that the vertical reinforcing ribs 32 on the container body 12 comprise side walls 64, 66 which extend inwardly from the side wall panels 26 toward and finally around the vertical

reinforcing rods 56 of the reinforcing members 54. These rib walls merge and are inwardly joined about the latter rods, as shown. The rib walls 64, 66 are integrally joined along their outer edges to the side wall panels 26, along their upper edges to the lower wall 62 of the stacking ledges 28, and along their lower edges to the curved walls of raised, underlying rib formations 68 and the bottom wall 14 of the container. These latter rib formations extend inwardly from the lower edge portions 26D of the side wall panels 26 to the rib formations 42 in the bottom wall 14. In the regions between the side wall panels 26 and the reinforcing members 54, the rib walls 64, 66 have contacting, confronting surfaces which extend outwardly through the outer sides of the container side walls 16 to join the outer surfaces of the side wall panels 26. As may be best observed in FIGURE 4, the side wall panels 26 curve inwardly, in the regions of the reinforcing ribs 32 to join the outer edges of the rib walls 64, 66 in such a way as to define the channels or grooves 34 in the side walls 16.

The portions of the upper walls 60 of the stacking ledges 28, which curves up and over the horizontal reinforcing rods 58 on the reinforcing members 54 define, on the stacking ledges upper, upwardly presented, convex stacking surfaces 70 of generally circular curvature in transverse cross-section. The surfaces of channels or grooves 24 in the under side of the bottom wall 14 of the container define lower, downwardly presented, concave stacking surface 72 of generally circular curvature in transverse cross-section. The radii of curvature of the upper and lower stacking surfaces 70, 72 are approximately the same. The lower ends of the vertical reinforcing rods 56 of the reinforcing members 54 terminate at the bottom wall rib formations 22 and mount plastic tips 74, for reasons to be explained presently. It is significant to note, at this point, that the central axes of the several reinforcing rods of each reinforcing member 54 and the axes of curvature of the adjacent upper and lower stacking surfaces 70, 72 are located approximately in a common verticel plane normal to the bottom wall 14 of the container.

From the preceding description, it is evident that each reinforcing member 54 extends between and into vertical supporting relation with the adjacent stacking shoulder 28 and the bottom wall 14 of the container in line with the adjacent upper and lower stacking surfaces 70 and 72. Accordingly, each reinforcing member may also be said to extend between and into vertical supporting relation with the adjacent upper and lower stacking surfaces.

Container 10 is adapted to be stacked with other light containers, one on top of the other, in the manner illustrated in FIGURES 8 through 11, to form a vertical container stack wherein the lower stacking surfaces 72 of each container rest on the upper stacking surfaces 70 of the adjacent lower container. When the containers are stacked in this way, the bottom of each container in the regions of its reinforced end walls 16, nests within the portions of the rim 30 on the adjacent lower container which extend along the upper edges of the side walls 16 and then along the upper edges of the side walls 18 to the recesses 40 of the latter container. For convenience, the rim portions which extend along the upper edges of the container side walls 16 are designated by the reference numeral 30A and the rim portions which are located at opposite ends of the stacking shoulders 28 and extend from the rim portions 30A to the container recesses 44 are designated by the reference numeral 30B. In the stacked and nested positions of the containers, just referred to, the lower edge portions 26B of the side walls 16 of each container fit between the rim portions 30A of the adjacent lower container and the leg formations 40 of each container fit between the rim portions 30B of the adjacent lower container. According to the preferred practice of the invention, the space in between the lower edge portions 26B of the container side walls 16 is related to the space in between the rim portions 30A, and the space in between the outer surfaces 42 of the container leg formations 40, at opposite sides of the container is related to the space in between the rim portions 30B, in such manner as to provide an interference fit between adjacent nesting containers in a container stack, thereby to frictionally restrain and secure the adjacent containers against separation under the action of road-shock encountered by the stacked containers when the latter are transported in an empty condition.

In addition to their other functions, discussed above, the rim portions 30B, leg formations 40, and upper and lower stacking surfaces 70, 72 provide locating means on the top and bottom of the container 10 which are adapted for interengagement with the lower and upper locating means, respectively, on the adjacent containers in a container stack to relatively locate the adjacent containers in both edgewise directions of the bottom wall 14 in positions wherein the corresponding vertical, load-bearing reinforcing rods 56 of the adjacent containers are vertically or coaxially aligned. In this regard, it is evident that the rim portions 30B and leg formations 40, by virtue of their interference fit producing relationship mentioned above, provide upper and lower locating means, respectively, on the container 10 for vertically aligning the corresponding vertical reinforcing rods 56 of adjacent stacked containers in one edgewise direction of the bottom wall 14, i.e. in the lengthwise direction of the stacking ledges 28. In other words, frictional nesting engagement of the lower leg formations, or lower locating means 40 on each container between the upper rim portions, or upper locating means 30B on the adjacent lower container in the container stack vertically aligns the vertical reinforcing rods 56 in the adjacent containers lengthwise of the stacking shoulders 28. Vertical alignment of the vertical reinforcing rods 56 in adjacent stacked containers in the opposite edgewise direction of the bottom wall 14, that is in a direction parallel to the container side walls 18 and transverse to the stacking ledges 28, is accomplished by the engaging or mating stacking surfaces 70, 72 on the adjacent containers. Thus, referring to FIGURES 8 and 11, it will be observed that when a number of the containers are stacked, the convex upper stacking surfaces 70 on each container enter the channels or grooves 24 defined by the lower stacking surfaces 72 on the adjacent upper container to relatively locate the adjacent containers in a direction parallel to the container side walls 18 and in a position wherein the corresponding vertical reinforcing rods 56 in the adjacent containers are vertically or coaxially aligned. It is evident, of course, that the frictional nesting engagement of the lower edge portions 26B of the side walls 16 of each container between the rim portions 30A of the adjacent lower container also tends to relatively locate the adjacent containers in the latter direction. However, the interengaging stacking surfaces 70, 72 on the adjacent stacking containers provides a more effective and positive aligning or locating action for retaining the vertical reinforcing rods 56 of the adjacent containers in vertical alignment under load. This more positive aligning or locating action furnished by the stacking surfaces is desirable or necessary, when the containers are loaded, since there is then a tendency for the lower ends of the vertical reinforcing rods of one container to shift to one side or the other of the horizontal reinforcing rods 58 of the adjacent lower container.

It is evident from the above discussion that when a number of the present containers are stacked one on top of the other, in loaded condition, the vertical stacking load imposed on any given container by the overlying containers is transmitted from the vertical reinforcing rods 56 of the adjacent upper container directly to the vertical reinforcing rods in the given container, and then through these latter rods directly to the vertical reinforcing rods in the adjacent lower container. Accordingly, the reinforcing members 54 in the containers carry the major portion of the stacking load imposed on each container. It is sig-

nificant to note at this point that the side wall panels **26**, stacking ledges **28**, stacking ribs **32**, and reinforcing members **54** tend to mutually reinforce and stabilize one another. Thus, for example, when a number of the containers are stacked in loaded condition, the vertical reinforcing rods **56** of the containers are subjected to bending loads and to lateral forces which tend to shift the reinforcing members **54** of adjacent containers out of vertical alignment. The stacking ledges **28** and reinforcing ribs **32** tend to reinforce and stabilize the reinforcing members against bending and lateral deflection under the action of such loads and forces. Conversely, the stacking ledges, reinforcing ribs, and reinforcing members tend to reinforce the side wall panels **26**. The sloping portions **26A**, **26C**, **38A**, **38C**, of the container side walls **16**, **18** also serve to reinforce these walls.

It will be immediately apparent to those skilled in the art that the body **12** of the container **10** described above may be constructed of various materials and may be fabricated by various manufacturing techniques. According to the preferred practice of the invention, however, the container is constructed of plastic and is fabricated by the unique vacuum forming process or method which will now be described in connection with FIGURES 13 through 17. In these latter figures, there is illustrated a vacuum-forming mold or die **76** having a die cavity **78**. The inner surface of this die cavity is contoured to form a sheet of heated plastic into a container body having the shape described above and illustrated in the drawings when the sheet is forced outwardly against the side walls and bottom of the cavity. The various die cavity formations for this purpose will not be described except insofar as they relate to the present invention, which resides primarily in the incapsulated reinforcing members **54** and their associated container structure. With this in mind, the inner surfaces of the upstanding die side walls are formed with an inwardly projecting rib formation **80** which cooperates with the adjacent inner surfaces of the die side walls to form the sloping portions **26C**, **38C** of the container side walls **16**, **18** and the container rim **30**. The inner surfaces of two opposite side walls **82** of the die cavity have vertical grip formations **84** which form the channels or grooves **34** in the container side wall **16**. These rib formations extend from the bottom wall **86** of the die cavity to the upper edge of the adjacent portion **80A** of the cavity rib **80**. Rising from the bottom wall **86** of the cavity in spaced parallel relation to the cavity walls **82**, are rib formations **88**. These latter rib formations form the grooves or channels **24** in the bottom wall **14** of the container and thereby, the raised rib formations **22** which project above the upper surface of the bottom wall. Extending from the lower end of each vertical rib formation **84** in the die cavity **78** to the adjacent rib formation **88** is a rib formation **90** which rises above the bottom cavity wall **86** to a height somewhat greater than that of the rib formation **88**. The rib formations **90** have inwardly presented end faces **92** disposed in vertical planes parallel to and off-set slightly from the center lines of the respective bottom wall rib formations **88**. Rib formations **90** form the rib formations **68** on the bottom wall **14** of the container, at the lower ends of the reinforcing ribs **32**. The upper ends **84A** of the vertical die cavity rib formations **84** slope inwardly, as shown. The inwardly presented surfaces of these latter rib formations, and the upwardly presented surfaces of the die cavity rib formations **88**, **90** are curved in transverse cross-section, as shown.

Extending into the upper edges of the elevated portions **80B**, which extend along the die cavity side walls **92**, adjacent the side walls **82**, are notches **94**. The two notches **94** located adjacent each side wall **82** are disposed in a common vertical plane containing the longitudinal center line of the adjacent bottom wall rib formation **88**. As shown in FIGURES 13 through 15, these notches are proportioned to receive ferrules **96** for positioning the reinforcing members of the container **10** in the die cavity **78**. Each ferrule **96** has a bore **98** extending part-way therethrough and opening through one end thereof. These bores are proportioned to slidably receive the ends of the horizontal reinforcing rods **58** of the reinforcing members **54**.

When positioning the reinforcing members **54** in the die cavity **78**, the ferrules **96** are fitted on the ends of the horizontal reinforcing rods **58** of the reinforcing members, after which the outer ends of the ferrules are dropped into the notches **94** in the die cavity **80**. The vertical reinforcing rods **56** of the reinforcing members are so longitudinally dimensioned that when the reinforcing members are thus positioned in the cavity, the plastic tips **74** on the lower ends of the vertical reinforcing rods are located proximate to or axially seat against the upper rounded surfaces of the underlying rib formations **88**. The tips **74** seat laterally against the vertical end faces **92** of the adjacent bottom wall rib formations **90**. These latter end faces are properly off-set from the center lines of the adjacent rib formations **88** to locate the adjacent reinforcing members in a vertical plane.

As noted earlier, the container **10** is formed by a vacuum-forming method or process. To this end, the die **76** is provided with air passages (not shown) which terminate in a multiplicity of small ports **100** distributed over the upper edges of the die side walls **82**, **92** and the inner surfaces of the die cavity **78**. In actual practice, these air passages in the die are connected to both a source of pressurized air and to a vacuum pump to permit selective introduction of air under pressure into and evacuation of the die cavity.

According to the present vacuum-forming method of fabricating the container **10**, a sheet **102** of plastic to be formed is clamped, along its edges, in a frame **104** in accordance with conventional vacuum-forming practice, and is heated to the proper vacuum-forming temperature. The heated sheet is then placed over the die cavity **78** in contact with the upper edges of the die sidewalls, after which air under pressure is introduced into the die cavity to expand the sheet upwardly away from the cavity. Thereafter, the sheet is forced downwardly into the cavity by a descending ram **106**, again in accordance with conventional vacuum forming practices, and the die cavity is simultaneously evacuated. The plastic sheet **102** is thereby forced, by atmospheric pressure, outwardly against the inner surfaces of the die side walls **82**, **92** and downwardly against the bottom wall **86** of the cavity. Eventually, the portions of the sheet approaching the die side walls **82** encounter the suspended reinforcing members **54**. Thereafter, during continued outward movement of these sheet portions toward and into final contact with the die side walls **82**, the sheet, in effect, wraps itself around the vertical and horizontal reinforcing rods **56**, **58** of the reinforcing members in such a way as to incapsulate these members and form the stacking ledges **28** and the reinforcing ribs **32**. The outwardly moving plastic sheet portions which encapsulate the vertical reinforcing rods **56** encounter the vertical rib formations **84** on the die side walls **82**. These rib formations, as already noted, form the external grooves or channels **34** in the container side walls **16**. The basic purpose of the rib formations **84**, however, is to provide curved junctures between the container side wall panels **26** and the container reinforcing ribs **32**, thereby to avoid the formation of sharp, stress inducing corners at these junctures. Similarly, the upper, inturned ends **84A** of the rib formations **84** are designed to avoid the formation of sharp, stress-inducing edges at the junctures of the container side-wall panel **26**, stacking ledges **28**, reinforcing ribs **32**, and rim **30**. It is evident that the above described function of the vertical rib formations **84** on the die **76** requires accurate alignment with these rib formations, of the vertical reinforcing rods **56** of the reinforcing members **54**. To this end, the bores **98** in the ferrules **96** for suspending the reinforcing members in the die cavity are drilled to the proper depth to accurately align the vertical reinforcing

rods with the vertical, die cavity rib formations **84**, when the ends of the ferrules seat against the adjacent die side walls, as shown thus in FIGURE 15.

The outwardly expanding plastic sheet being vacuum-formed, obviously, exerts substantial outward pressure against the reinforcing members **54**, tending to move these members toward the adjacent die side walls **82**. This outward pressure on the reinforcing members is resisted, in part, by engagement of the ferrules **96** with the side-walls of the ferrule receiving slots **94** and in part by engagement of the lower plastic tips **74** on the reinforcing members against the end faces **92** of the lower rib formations **90** on the bottom wall of the die cavity.

If the plastic tips **74** were omitted from the reinforcing members **54**, the lower ends of the vertical rods **56** of these members would directly contact the die cavity rib formations **90**. The plastic sheet being vacuum-formed, therefore, would not be able to completely incapsulate the lower ends of these rods, with the result that such ends would be exposed in the finished container. This exposure of the reinforcing rods is undesirable for the reason that corrosion of the rods would occur. The plastic tips **74** are provided on the reinforcing members **54** to eliminate such corrosion. Thus, in the finished container, these tips are partly exposed, as may be observed in the drawings, because of their contact with the die cavity rib formations **90** during the vacuum-forming process. However, these tips completely enclose the lower ends of the vertical reinforcing rods **56** and thereby shield these rods against corrosion.

At the conclusion of the vacuum-forming process, the vacuum-formed container is permitted to cool in the die cavity **78**. During this cooling, the container shrinks sufficiently to permit it to be lifted out of the die cavity. Thereafter, the excess plastic is removed from the container by routing or otherwise cutting the container along the upper edge of the container rim **30**. The excess plastic is thus removed in such a way as to form the recesses **44** in the upper edges of the container. When a number of the containers are stacked, in the manner described earlier, these recesses provide openings between adjacent containers which may be used for ventilation purposes as well as to permit dusting of the contents of the containers, when such contents are agricultural products, such as tomatoes.

Depending upon the particular material from which the present container is constructed and/or the method which is used to fabricate the container, the confronting walls **64**, **66** of the container reinforcing ribs **32** and the confronting walls **60**, **62** of the container stacking ledges **28** may fuse together to form integral wall structures, or these rib and ledge walls may remain in unfused contact. Fusion of the confronting rib and ledge walls will occur, for example, when the container is constructed of polyethylene or polypropylene and is fabricated by the vacuum forming process described above. On the other hand, fusion of the walls may not occur if the container is constructed of various other plastics. According to the preferred practice of the invention, the container is fabricated in such a way as to achieve fusion of the confronting walls of the ribs **32** and stacking ledges **28**, as by constructing the container of polyethylene or polypropylene and vacuum forming the container in the manner explained above.

Fusion of the confronting rib walls **64**, **66** and stacking ledge walls **60**, **62** is desirable for the reason that such fusion prevents the entrance of moisture between these walls which would cause corrosion of the reinforcing members **54**. In this connection, attention is again directed to the earlier discussion relating to the plastic tips on the vertical reinforcing rods **56** which prevent corrosion of the lower ends of these rods. After removal of the present container from the cavity **78** in the die **76** following vacuum forming of the container, the ferrules **96** are removed, thereby leaving openings in the container side walls at the ends of the horizontal reinforcing rods **58**. These openings are closed by plastic seals, as shown in FIGURE 6. It is apparent, therefore, that the reinforcing members **54** are totally incapsulated within the container side walls **16** and are thereby totally shielded against corrosion.

The container illustrated in the drawings is designed to support substantial stacking loads on the order of 1500 pounds. If such great stacking strength is not required, the vertical reinforcing rods **56** may be eliminated and in this case, the horizontal rods **58** are retained primarily to serve as forms about which the plastic material of the box forms itself during the vacuum forming process, thereby to form the stacking ledges **28** and the upper convex stacking surfaces **70**. The horizontal rods, of course, will continue to reinforce the stacking ledges and the container as a whole to some degree. These rods, for example, will transmit stacking loads in the stacking ledges to the container side walls and will reinforce the container side walls against bowing outwardly.

While the invention has herein been shown and described in what is presently conceived to be its most practical and preferred embodiment and practice, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein, but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

Having described the invention, what is claimed as new in support of Letters Patent is:

1. A stacking container comprising:

a generally rectangular bottom wall bounded by upstanding side walls, said container having upper, upwardly presented stacking surfaces along the upper edges of two opposite side walls and lower, downwardly presented stacking surfaces at the under side of said bottom wall directly below said upper stacking surfaces, respectively, metal reinforcing members including vertical load-bearing reinforcing rods extending between and into vertical supporting relation with the vertically aligned upper and lower stacking surfaces, respectively, said container being adapted to be stacked with other like containers one on top of the other to form a vertical container stack, wherein said lower stacking surfaces on each container rest on said upper stacking surfaces of the adjacent lower container, and said container including upper and lower locating means at the top and bottom of said container, respectively, adapted for interengagement with the lower and upper locating means on adjacent containers in said container stack for relatively locating the adjacent containers in positions wherein the corresponding vertical reinforcing rods in the adjacent containers are approximately vertically aligned.

2. A stacking container according to claim **1** wherein:

each of said stacking surfaces extends crosswise of said container approximately parallel to said opposite side walls, each of said reinforcing members comprises a pair of said vertical load-bearing reinforcing rods, and said reinforcing rods of each reinforcing member being spaced along their respective upper and lower stacking surfaces.

3. A stacking container according to claim **1** wherein:

each of said reinforcing members comprises a pair of said load-bearing reinforcing rods, and a horizontal reinforcing rod rigidly joined to one end of the respective vertical reinforcing rods, said horizontal reinforcing rods being disposed in vertical supporting relation to their adjacent stacking surfaces, and said vertical reinforcing rods being generally symmetrically located at opposite sides of the center line of said container extending between said opposite side walls.

4. A stacking container according to claim **1** wherein:

said reinforcing members are incapsulated within said two opposite container side walls, respectively.

5. A stacking container comprising:

a one-piece molded plastic body including a generally rectangular bottom wall bounded by upstanding side walls, said container body having upper, upwardly presented stacking surfaces along the upper edges of two opposite side walls of said body and lower, downwardly presented stacking surfaces at the underside of said bottom wall directly below said upper stacking surfaces, respectively, metal, load-bearing reinforcing members incapsulated within said opposite side walls and extending between and into vertical supporting relation with the adjacent upper and lower stacking surfaces, and said container being adapted to be stacked with other like containers one on top of the other to form a vertical container stack, wherein said lower stacking surfaces on each container rest on said upper stacking surfaces of the adjacent lower container and the corresponding reinforcing members of adjacent containers are approximately vertically aligned, whereby the vertical stacking load imposed on each container in said stack is transmitted through the reinforcing members of the respective container directly to the reinforcing members, respectively, of the adjacent lower container.

6. A stacking container according to claim 5 wherein:

said load-bearing reinforcing members comprise vertical load-bearing reinforcing rods extending between and into vertical supporting relation with the respective adjacent upper and lower stacking surfaces, and said container comprises complementary upper and lower locating means at its top and bottom adapted for interengagement with the lower and upper locating means, respectively, on adjacent containers in said container stack to relatively locate the adjacent containers in both edgewise directions of said bottom wall in positions wherein said vertical reinforcing rods of the adjacent containers are approximately vertically aligned.

7. A stacking container according to claim 5 wherein:

said stacking surfaces extend crosswise of said container generally parallel to said opposite side walls, each of said reinforcing members comprises a pair of vertical, load-bearing reinforcing rods extending between and into vertical supporting relation with the respective adjacent upper and lower stacking surfaces and a horizontal load-bearing reinforcing rod rigidly joined to one end of the respective vertical reinforcing rods, said vertical reinforcing rods of each reinforcing member being spaced lengthwise of the respective stacking surfaces, and the horizontal reinforcing rod of each reinforcing member extending lengthwise of the respective adjacent stacking surface in vertical load-bearing relation therewith, and said container comprising upper and lower locating means at the top and bottom of the container, respectively, adapted for interengagement with the lower and upper locating means, respectively, on adjacent containers in said container stack for relatively locating the adjacent stacked containers in positions wherein the corresponding vertical reinforcing rods of the adjacent containers are approximately vertically aligned.

8. A stacking container according to claim 5 wherein:

an upstanding locating rim about the top of said container, locating formations along the lower edges of the remaining container side walls, respectively, the vertically aligned upper and lower stacking surfaces having complementary shapes and being adapted for interengagement with the stacking surfaces on adjacent upper and lower containers in said container stack to relatively locate the adjacent stacked containers in one edgewise direction of said bottom wall, and said rim and locating formations on said container being adapted for nesting interengagement with with the locating formations and rim, respectively, of the adjacent containers for relatively locating the adjacent containers in the opposite edgewise direction of said bottom wall.

9. A stacking container comprising:

a one-piece molded plastic body including a generally rectangular bottom wall bounded by upstanding side walls, two opposite side walls of said body including panels disposed generally in planes normal to said bottom wall, generally horizontal stacking ledges along the upper edges of said panels, respectively, and extending laterally beyond corresponding sides of said panels approximately in a common plane generally parallel to said bottom wall, said stacking ledges defining upper, upwardly presented stacking surfaces, said bottom wall having lower, downwardly presented stacking surfaces at the underside of said bottom wall directly below said upper stacking surfaces, respectively, metal, load-bearing reinforcing members extending between and into vertical supporting relation with said stacking ledges and said bottom wall in line with the vertically aligned upper and lower stacking surfaces, respectively, and said container being adapted to be stacked with other like containers one on top of the other to form a vertical container stack, wherein said lower stacking surfaces on each container rest on said upper stacking ledges of the adjacent lower container and the corresponding reinforcing members of the adjacent containers in said stack are approximately vertically aligned.

10. A stacking container according to claim 9 wherein:

each of said reinforcing members comprises a pair of vertical, load-bearing reinforcing rods extending between and into vertical supporting relation with the respective adjacent stacking ledge and said bottom wall in line with the respective adjacent upper and lower stacking surfaces and a horizontal, load-bearing reinforcing rod rigidly joined to the upper ends of the respective vertical reinforcing rods and extending lengthwise of the respective stacking ledge in vertical supporting relation therewith.

11. A stacking container according to claim 9 wherein:

each of said opposite side walls includes reinforcing ribs projecting laterally from the respective side wall panel in the same direction as the adjacent stacking ledge and extending between the latter ledge and said bottom wall, and each of said reinforcing members comprises load-bearing reinforcing rods incapsulated within the adjacent reinforcing ribs and extending between and into vertical supporting relation with the adjacent stacking ledge and said bottom wall in line with the respective upper and lower stacking surfaces and a load-bearing reinforcing rod incapsulated within and extending lengthwise of the adjacent stacking ledge in line with the respective upper stacking surface and rigidly joined to the upper ends of the respective first mentioned reinforcing rods.

12. A stacking container according to claim 9 wherein:

each of said opposite side walls comprises a pair of vertical reinforcing ribs which project laterally from the respective side wall panel in the same direction as the adjacent stacking ledge and extend between the latter ledge and said bottom wall, said ribs being spaced lengthwise of the respective stacking ledges, and each of said load-bearing reinforcing members comprises a pair of vertical, load-bearing reinforcing rods incapsulated within the adjacent reinforcing ribs, respectively, and extending between and into vertical supporting relation with the adjacent stacking ledge and said bottom wall in line with the respective upper and lower stacking surfaces and a horizontal, load-bearing reinforcing rod incapsulated within and extending lengthwise of the adjacent stacking ledge in line with the respective upper stack-

ing surface and rigidly joined to the upper ends of the respective vertical reinforcing rods.

13. A stacking container according to claim 9 wherein:

each of said opposite side walls comprises a pair of vertical reinforcing ribs which project laterally from the respective side wall panel in the same direction as the adjacent stacking ledge and extend between the latter ledge and said bottom wall, said ribs being spaced lengthwise of the respective stacking ledges, and each of said load-bearing reinforcing members comprises a pair of vertical, load-bearing reinforcing rods incapsulated within the adjacent reinforcing ribs, respectively, and extending between and into vertical supporting relation with the adjacent stacking ledge and said bottom wall in line with the respective upper and lower stacking surfaces and a horizontal, load-bearing reinforcing rod incapsulated within and extending lengthwise of the adjacent stacking ledge in line with the respective upper stacking surface and rigidly joined to the upper ends of of the respective vertical reinforcing rods, each of said reinforcing ribs comprising a pair of side walls which extend from the respective side wall panel toward and finally around the respective vertical reinforcing rod, said side walls of each reinforcing rib having contacting, confronting surfaces in the region between the respective side wall panel and vertical reinforcing rod and being integrally joined along the respective vertical reinforcing rod, each of said stacking ledges comprising upper and lower walls which extend from the adjacent side wall panel toward and finally around the respective horizontal reinforcing rod, and said upper and lower walls of each stacking ledge having contacting, confronting surfaces in the region between the respective side wall panel and horizontal reinforcing rod and being integrally joined along the latter rod.

14. A stacking container comprising:

a one-piece molded plastic body having an open top and including a generally rectangular bottom wall bounded by upstanding side walls, two opposite side walls of said body including panels disposed generally in planes normal to said bottom wall, generally horizontal inwardly projecting stacking ledges along the upper edges of said panels, respectively, generally vertical inwardly projecting reinforcing ribs on said panels extending vertically between said stacking ledges, respectively, and said bottom wall, said stacking ledges defining upper, upwardly presented, convex stacking surfaces extending lengthwise of said stacking ledges, respectively, said bottom wall having lower, downwardly presented, concave stacking surfaces at the underside of said bottom wall directly below said upper stacking surfaces, respectively, an upstanding rim about the open top of said body rising above said upper stacking surfaces at least in the regions of the ends of said upper stacking surfaces, metal load-bearing reinforcing members including vertical load-bearing reinforcing rods incapsulated within said reinforcing ribs respectively, and extending between and into vertical supporting relation with said stacking ledges and said bottom wall in line with the vertically aligned upper and lower stacking surfaces, and horizontal load-bearing reinforcing rods rigidly joined to the upper ends of the respective vertical reinforcing rods and incapsulated within said stacking ledges, respectively, in vertical supporting relation with said upper stacking surfaces, said reinforcing ribs having contacted side walls in the regions between their respective side wall panels and vertical reinforcing rods and being integrally joined around the latter rods and said stacking ledges having contacting upper and lower walls in the regions between their respective side wall panels and horizontal reinforcing rods and being integrally joined around the latter rods, the contacting surfaces of said rib walls joining the outer surfaces of said side wall panels, respectively, and the contacting surfaces of said ledge walls joining the outer surfaces of said side wall panels and rim, respectively, and said container being adapted to stack with other like containers one upon the other to form a vertical container stack, wherein the bottom of each container nests within said rim of the adjacent lower container and said lower stacking surfaces on each container rest on said upper stacking surfaces of the adjacent lower container in such manner as to locate the corresponding vertical reinforcing rods of adjacent containers in approximate vertical alignment.

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