March 29, 1966 K. L. CRABTREE 3,243,095

PULP PARTITION MOLDING

Filed Dec. 8, 1964 2 Sheets-Sheet 1

Fig. 1.

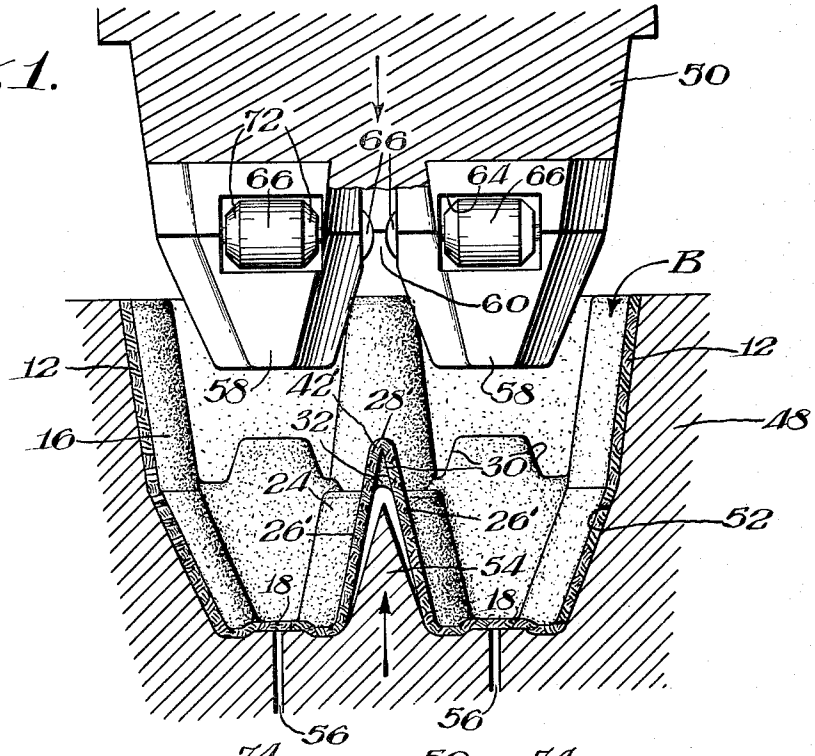


Fig. 2.

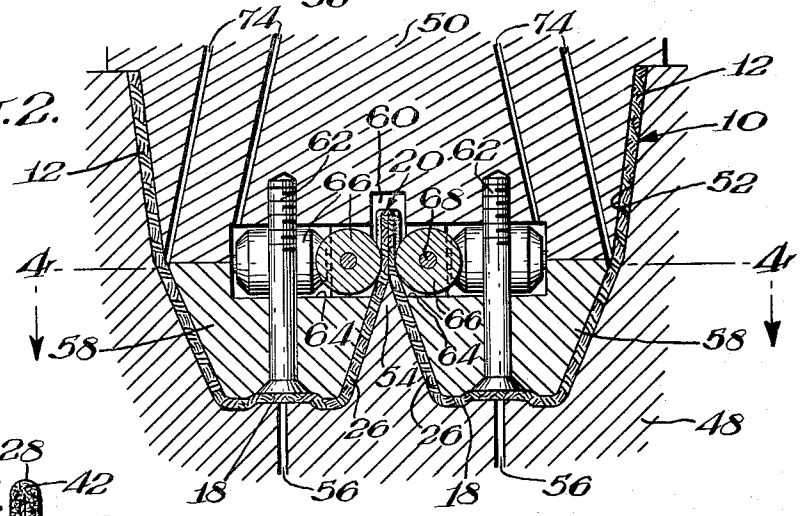
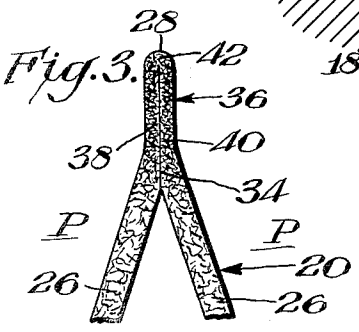


Fig. 3.



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Fig. 5.

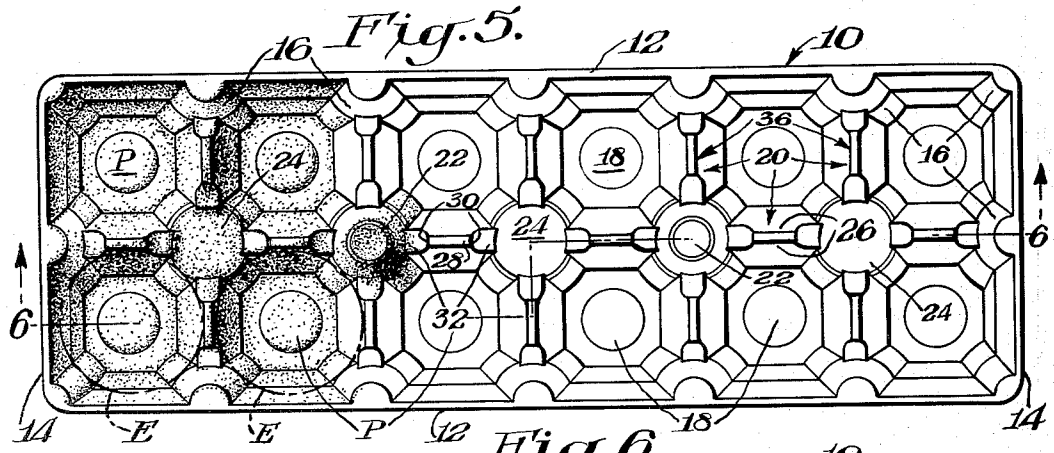


Fig. 6.

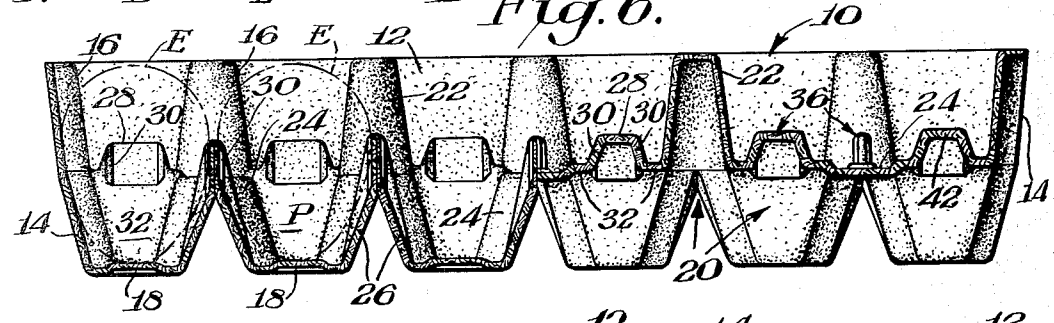


Fig. 7.

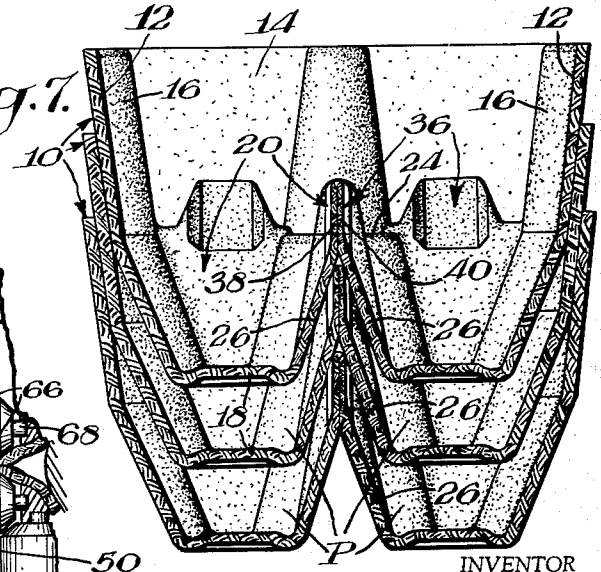
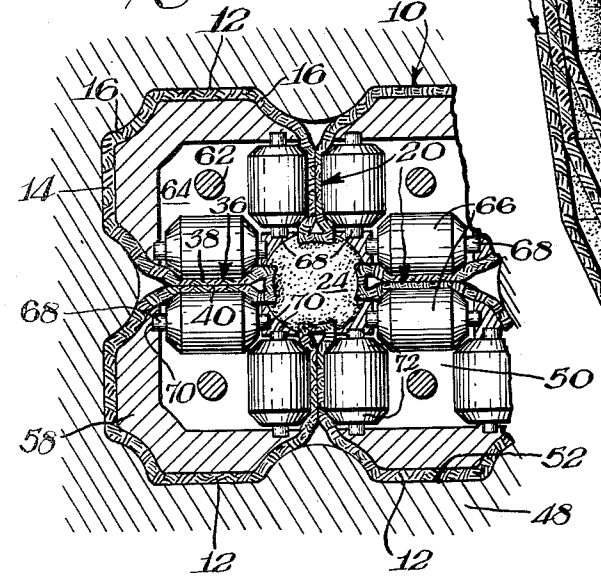


Fig. 4.



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PULP PARTITION MOLDING

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10 Claims. (Cl. 229—2.5)

This is a continuation-in-part of co-pending application Serial No. 834,759, filed August 19, 1959, for an Egg Carton. This invention relates to improved partition structure and to method and apparatus for molding such partition structure, and more particularly to the molding of fibrous pulp material to form containers having improved after-pressed rib structure separating adjacent downwardly dished article receiving pockets.

Prior to the present invention, the commercial manner of forming partition or separating structure to define individual article receiving pockets in molded pulp containers makes use of pocket side walls which slope upwardly and outwardly from the bottom or base walls of the pockets, and the side walls between two adjacent pockets converge with each other in inverted U- or V-shape fashion. Such converging double walled structure is frequently referred to as rib structure, and has proved generally satisfactory for separating or defining individual article receiving pockets in molded pulp packaging containers as well as adding strength to the containers.

Certain problems, however, are connected with the use of such double walled rib structure when it serves the function of partitioning or separating article receiving pockets. Referring particularly to molded pulp egg cartons to emphatically illustrate some of these problems, but bearing in mind that the instant invention is by no means limited to egg cartons alone, the necessary draft angle or slope of the rib walls unfortunately utilizes horizontal space which frequently can be ill-afforded. For instance, the increasing prevalence of larger sizes of eggs which must be packaged in egg cartons having a standard maximum outer dimension, limited to available packaging case sizes, requires that the double walled rib structure have a relatively low height. As can be understood, because of the draft angle necessary for removing the damp molded pulp containers from the open face suction forming die, the height of the double walled ribs has heretofore been limited in a manner inappropriate for the most desirable egg packaging conditions. If the rib walls which must include the reasonable draft angle are beyond a given height, the eggs will not be bunched sufficiently close to one another to maintain the required outer carton dimension; whereas, if the ribs are made sufficiently low to permit the desired close packaging of eggs, the ribs because of their required draft angle do not extend high enough to separate the eggs one from another at their zone of maximum girth.

A number of approaches have been proposed for solving this dilemma. For higher quality egg cartons, where the low additional cost of after-pressing operations can be tolerated, the previous attempts to solve this problem have proved unsatisfactory from a commercial standpoint. For instance, from Reifers Patent 3,123,519 of March 3, 1964, a method of after-pressing the upper juncture of double walled rib structure is known, but this method fails to teach anything of commercial advantage. First, the cross-sectional shape of the after-pressed upper rib wall juncture is no different than that previously well-known to the art, such as in Koppelman Patent 1,919,028 of July 18, 1933. This structure is in essence an inverted V-shape structure where the apex of the V has a vertical pulp thickness somewhat greater than the normal thickness of the pulp walls of which the balance of the carton consists. Unfortunately, the horizontal thickness dimension through this inverted V structure near the upper

extremities thereof is obviously thinner than the unitary pulp thickness, and is of insufficient thickness to prevent lateral shifting or rattling of eggs having a high point of maximum girth. The horizontal thickness dimension through the inverted V structure at the lower portions thereof, on the other hand, is considerably greater than the unitary pulp thickness, and is thus too great to permit proper packaging of eggs having a low point of maximum girth.

Furthermore, the method taught by the Reifers patent is not commercially feasible. The downward movement of the upper after-pressing die which includes the inverted V-shape after-pressing cavity first engages the extreme upper surface of the double walled rib structure and supposedly presses the rib walls together to form an inverted V-shaped upper surface. In reality, however, the component of forces which initially act on the upper surface of the rib include considerably more vertically downward crushing force and considerably less horizontally inward pressing force than appears from a casual observation of the stylized patent drawings. As a result, the downward component of forces is, in fact, so great that the upper peak of the inverted V-shape after-pressing cavity fills with pulp only with extreme difficulty, if at all. If the fibrous pulp material is sufficiently soggy, and the pressure applied by the after-pressing dies is sufficiently great, the pulp may be squeezed hydraulically up into the peak of the V-shape cavity. However, pulp of the requisite water content cannot conveniently be removed from the forming die with the expediency and dependability found mandatory for mass production operations, and the required magnitude of hydraulic pressure would result in prohibitively expensive modifications of existing after-pressing machinery. As such, the disclosure of this Reifers patent amounts to no more than a laboratory curiosity, and even when followed under laboratory conditions produces an inverted V-shape rib structure identical with structure which has long been available in the art.

Accordingly, it is a primary object of the present invention to provide partition structure wherein a pair of rib walls converge with each other to a zone of confluence and merge into a partition wall which extends to a height substantially above the zone of confluence, the thickness of the partition wall being substantially constant or uniform throughout the full vertical extent thereof, and the density of the fibrous pulp material of the partition wall being substantially greater than the density of the fibrous pulp material of the balance of the container.

The uniform cross-sectional thickness throughout the vertical height of the partition structure is extremely useful to accommodate eggs wherein the zone or point of maximum girth may occur at any point within a given height range. When the point of maximum girth of a large egg is on the lower side of this range, the inverted Y-shape partition structure of this invention permits packaging of such an egg to the full desired depth in the pocket. When the point of maximum girth of an egg is on the higher side of the height range, the inverted Y-shape partition structure of this invention prevents lateral shifting or rattling of eggs packaged in the pockets. In either case, of course, the upstanding tail or tab of the inverted Y-shape partition structure extends at least to the point of maximum girth of any normally encountered egg and prevents checking of eggs packaged in the improved egg carton of this invention.

The increased density of the upper or tail portion of the inverted Y-shape partition structure of this invention is desirable to achieve improved "memory" or resiliency of the pulp itself. Partition structure which is contacted from both sides by eggs in adjacent pockets encounters more compressive effect from the eggs than other portions of the carton. Where single thickness partition structure

is formed of pulp having an average density value, continued pressure from opposite sides, especially when such cartons are reused time and time again, the pulp eventually assumes a compressed state forming undesirable inwardly contoured depressions. By increasing the density of the pulp in the partition structure, on the other hand, it has been discovered that the resistance to permanent deformation or compression of the pulp fibers is reduced without noticeably sacrificing the advantageous cushioning characteristics of the pulp fibers.

Another object of the present invention is to provide a method of molding pulp partition structure wherein double walled rib structure is finish formed by after-pressing at least the upper portions directly against each other to decrease the total effective separation between adjacent pockets while maintaining a substantially constant or uniform thickness throughout the full vertical height of the pressed together upper portions and to increase the density of the fibrous pulp material in the pressed together portions. The method of this invention produces superior partition structure in a commercially feasible fashion requiring neither excessive water content in the pulp nor excessive pressure in the after-pressing machinery.

Another object of the present invention is to provide apparatus for molding improved partition structure of inverted Y-shape cross-sectional configuration wherein one after-pressing die is characterized by roller devices positioned to press upper portions of double walled rib structure together in a manner which obtains a desired constant or uniform thickness dimension throughout the full vertical height of the pressed together portions.

Other objects and advantages of the present invention will become apparent to one skilled in the art from a reading of the following description in conjunction with the accompanying drawings, wherein similar reference characters refer to similar parts, and in which:

FIG. 1 is a transverse sectional elevational view showing a portion of a partially finished molded pulp container positioned between opened after-pressing apparatus;

FIG. 2 is a transverse sectional elevational view showing a portion of a molded pulp container positioned between closed after-pressing apparatus;

FIG. 3 is a fragmentary sectional elevational view transversely through pocket partition structure showing the uniform thickness throughout the vertical height as well as the increased density thereof;

FIG. 4 is a sectional elevational view on line 4—4 of FIG. 2 showing further details of the container and the after-pressing apparatus;

FIG. 5 is a plan view of an egg carton or container embodying the partition structure of this invention;

FIG. 6 is a sectional elevational view on line 6—6 of FIG. 5 showing further details of the egg carton; and

FIG. 7 is a transverse sectional elevational view of several egg cartons stacked in mutually nested relationship.

Referring in more particularity to the drawings, the improved partition structure for containers is illustrated for convenience in combination with a preferred variety of 2 x 6 egg carton **10** best illustrated in FIGS. 3, 5, 6 and 7. Such a carton **10** is composed of molded fibrous pulp material and comprises a pair of side walls **12** and end walls **14** secured together at the four corners of the generally elongated rectangular tray. A plurality of vertically extending indentations taking the form of partial posts **16** are formed at the corners and along the sides and ends of the carton as integral portions of the side and end walls to increase the vertical strength of the walls as well as to partially define article receiving pockets P in the container.

The side walls **12** and end walls **14** are integrally connected at their bottoms with horizontally disposed base or bottom pocket walls **18** at spaced locations between the partial posts **16**. Extending longitudinally along the mid-portion of the carton as well as laterally of the carton are a plurality of partition structures **20**. The laterally extending partition structures **20** are connected at one end to a partial post **16** positioned marginally of the tray, and are connected at their other end with a series of alternately arranged high center posts **22** and low center posts **24**. The longitudinally extending partition structures **20** are connected between the high and low center full posts **22** and **24**. The partition structures **20** are integrally connected at their bottoms with the base or bottom walls **18** of the pockets to slope upwardly and outwardly therefrom. Thus, each pair of adjacent pockets P is separated by partition structure comprising a pair of upwardly converging pocket side walls or rib walls **26** which are joined together at their upper portions.

The upper joined together portions of the converging walls **26** of each partition structure preferably have a mid-portion which extends at least to a height sufficient to separate eggs placed in the pockets at the point or zone of maximum girth of the eggs. The upwardly extending portions include an upper edge **28** as well as end edges **30** joined at their lower extremities to the upper portion of the rib walls **26** where the rib walls are joined together as at **32** on opposite ends of the upstanding mid-portion. The lower joined together portions **32** merge integrally with the partial post structure along the outer margin of the carton, or with the low post or high post structure along the longitudinal centerline of the carton.

In cross-sectional elevational view transversely of the partition structure **20**, as best seen in FIG. 3, the rib or pocket side walls **26** converge toward each other in an upward direction. As can be seen at **34**, the walls merge with each other at a zone of confluence into a partition wall **36** which extends upwardly from the zone of confluence **34** to a height substantially above the zone of confluence. This, in cross-sectional elevation view transversely through the partition structure **20**, defines an inverted Y-shape configuration. The thickness of the partition wall **36**, which constitutes the tab or tail of the inverted Y, is constant or uniform throughout the full vertical extent thereof, and the density of the fibrous pulp material of the partition wall is substantially greater than the density of the fibrous pulp material of the pocket side walls **26**, as can be seen by the closeness of the lines which simulate fibrous pulp material in FIG. 3. In the preferred embodiment as illustrated in FIG. 3, the uniform thickness of the partition wall or anti-check tab **36** is substantially the same as the thickness of each of the pocket side walls **26**, and the density of the fibrous pulp material of the partition wall **36** is substantially twice the density of the pulp in the pocket side walls **26**. Also, as can be seen in FIG. 3, the partition wall **36** comprises two adjacent layers **38** and **40** which conveniently may be integrally joined together at their tops as at **42**, the two adjacent layers **38** and **40** being integral with their respective pocket side walls **26**. Additionally, it will be noted that the portion **36** of uniform thickness is bounded at least partially on the lateral ends thereof by thickened partition wall structure in the edge zones **30**.

One method of producing the above described exemplary product may be performed with the following apparatus. A first after-pressing die **48** and a second after-pressing die **50** are mounted for relative to-and-fro motion in a conventional manner, not shown, to permit placement of a partly formed egg carton between the dies prior to movement of the dies toward each other. The after-pressing die **48** includes a cavity **52** designed to loosely receive the exterior of the egg carton in the shape it is received from the conventional drying apparatus. Additionally, the cavity **52** includes central upstanding projections **54** which do not mate with the outside or lower surface of the partly formed carton ribs. The projections **54** taper to a sharp ridge at their upper extremity, and are designed to conform with the desired shape of the lower or outer side of the partition structure of the finished carton. Exhaust ports **56** may

be provided in the conventional fashion for expelling after-pressed egg cartons from the cavity **52**.

The upper after-pressing die **50** is formed to define the desired interior configuration of the egg carton. As such, the die **50** includes a plurality of protrusions **58** adapted to define the downwardly dished pockets P of the finished egg carton. Between adjacent downwardly dished protrusions **58**, there remains a series of interconnected recesses **60** adapted to receive the upwardly extending pocket separating ribs of the carton.

The pocket forming protrusions **58** may be formed as separate segments secured as at **62** to the main portion of the upper die **50**. In this manner, a cavity arrangement **64** may be provided for positioning a plurality of shiftably mounted pressing elements such as roller devices **66**. Each roller device **66** is provided with central axially extending trunnion pins **68** adapted to be rotatably received in split bearing apertures **70** machined into the upper after-pressing die at the separation plane where the pocket forming protrusions **58** are secured to the upper main portion of the die. The outer surface of the rollers **66** are cylindrical in the main, and include beveled or chamfered end portions **72**. When the upper after-pressing die **52** is properly assembled as illustrated, the distance between the outer cylindrical face of opposed roller elements **66** on either side of each partition wall receiving recess **60** approximates the unitary thickness of the pulp walls. The after-pressing die **50** may include exhaust ports **74** for insuring proper separation of the die **50** from an after-pressed egg carton. Additionally, certain exhaust ports **74** may be directed to the interior of the cavities **64** to expell fragments of fibrous pulp material which may inadvertently lodge therein during use of the apparatus.

One method by which the above described exemplary egg carton may be produced by use of the above described exemplary apparatus is as follows. First, an egg carton blank or partially finished container B is formed as a sheet or blanket of fibrous pulp material on an open-face suction die, not shown, in accordance with well-known procedures. The suction or forming die is contoured so that the partition structure of the container blank B is formed as indicated in FIG. 1 with the converging rib or pocket side wall portions **26'** angling upwardly to the uppermost zone of juncture **42'**. The walls **26'** when the carton blank is in this state of completion are separated throughout their full vertical extent, except if preferred at the uppermost zone of juncture **42'**, and are angled to permit easy separation from the contoured forming die. As such, the walls **26'** of the partition structure would be too greatly spaced from each other to permit storage of full size eggs in the adjacent pockets.

Thereafter, the water content is reduced somewhat in the sheet of pulp and the blank for the carton is removed from the screen covered forming die and transferred to the drying apparatus, The drying apparatus may conveniently be of any known variety, such as a flat dryer belt or a shaped drying form without a mating form on the reverse side of the article. When the carton is relatively dry, say 75% to 95% dry, it is placed between the after-pressing dies **48** and **50**. The carton blank B may conveniently be drawn by suction connected to the ports **56** to settle the carton blank into the cavity **52**, as indicated in FIG. 1. In this position, the walls **26'** of the partition structure are spaced from the upstanding central ridge formations **54**, especially at the upper portions thereof.

Then, the upper after-pressing die **50** and the lower after-pressing die **48** move relatively together. The depending pocket forming protrusions **58** engage the already roughly formed downwardly dished pockets of the carton blank. As the after-pressing dies **48** and **50** undergo their final increment of relative inward motion, the pockets are enlarged by laterally pressing paired walls **26'** together, and the roller elements **66** engage the central upstanding mid-portions of the partition structure. Thereafter, as the dies complete their inward pressing movement, the roller elements **66** compress the upper portions of the rib or pocket side walls together to achieve the layered effect indicated at **38** and **40** in FIG. 3. Because of the geometry of the rollers, the component of laterally inward pressing force is multiplied relative to the component of downward rib crushing force so the effective height of the partition wall is maintained without significantly increasing the normal after-pressing force. The portion of the pocket forming protrusions **58** immediately below the location of the roller devices **66** serves to after-press the lower portion of the rib or pocket side walls **26** against the upstanding central tapered portion **56**.

The dies also reduce the average wall thickness slightly, and iron out the surface roughness and irregularities resulting from the imprinting of the forming screen and from any warpage during drying. As is well known, of course, the after-press operation irons the surfaces by compression between dies to an extent necessary to produce a smooth surface for printing in some areas and sufficient to only remove warpage in other areas without reducing the thickness appreciably. The after-pressing can also be employed to slightly stretch the pockets or portions thereof to accommodate larger eggs.

As can be seen from FIGS. 2–4, the upstanding partition wall **26** is reduced to a total thickness corresponding to the single or unitary thickness of the balance of the walls of the egg carton. The thickness is determined by the distance between opposed roller devices **66**. Obviously, while the preferred embodiment illustrates rollers positioned to obtain exactly unitary or single thickness of the anti-check tab portion **36**, it will readily be appreciated that the upstanding partition wall may be made slightly thinner or somewhat thicker as desired by regulating the distance between the outer surfaces of the roller elements **66** associated with after-pressing die **50**.

The reduction in thickness of the partition wall results in a compression of the fibrous pulp material thereof to the point where the density of the partition wall **36** is substantially increased over the density of the average pulp wall in the balance of the egg carton. In the preferred embodiment, the density of the partition wall is approximately twice that of the balance of the walls. If the rollers are positioned slightly farther apart, the density will not be multiplied as much as if the outer surface of the rollers are spaced more closely than illustrated in the preferred embodiment.

In use, as can be seen in FIG. 7, the egg cartons **10** of this invention including the single thickness upstanding partition wall **36** may be nested compactly one within another for shipment to the egg packager. While suitable anti-jamming or de-nesting stops, not shown, ordinarily are provided in the upper portions of the partial post formations to prevent cartons from nesting to the point where their steep walls will frictionally engage to the extent where serious jamming would occur, it will be noted that the laminations **38**, **40** of the partition wall **36** of this invention may spread slightly to receive the upper portion **28** of the partition wall **36** of the next lower carton in a stack, if required. Upon removal of each carton from the stack, the after-pressed partition wall **36** will resume its proper configuration of uniform or constant thickness throughout its full vertical extent.

Upon arrival at the egg packagers, the cartons are denested from the stack and the downwardly dished pockets P filled with eggs in the conventional fashion. As can be seen by the outline of eggs E in two pockets in FIGS. 5 and 6, the side and end walls of the illustrated carton extend beyond the full vertical height of the eggs. The partition portions **36** extend at least to the point or zone of maximum horizontal girth of the eggs. Additionally, whether the point of maximum girth on a given egg is near the high or the low end of the ordinarily encountered range of such heights, the thickness of the partition por-

tion at that point is exactly the same, as desired. Additionally, the increased density of the partition structure is at the point which is contacted on opposite sides by eggs in adjacent pockets. The increased density resists permanent compression and deformation of pulp fibers in this zone to maintain desired minimum spacing between eggs while retaining the desired cushioning characteristics long associated with molded pulp.

Thus, an improvement in pulp partition molding has been disclosed which provides improved partition structure between downwardly dished article receiving pockets in molded pulp containers. The partition structure is characterized by a high, upstanding portion of uniform thickness and increased density throughout. Moreover, an improved commercially feasible after-pressing method for forming such desirable partition structure has been disclosed in conjunction with improved apparatus including rollably mounted after-pressing elements to obtain the preferred partition structure.

While the above disclosure constitutes the presently preferred mode of practicing this invention, many other structural embodiments and functional equivalents clearly may be resorted to within the legal scope of the actual invention, which is defined or claimed as follows.

What is claimed is:

1. A container molded of fibrous pulp material comprising a plurality of downwardly dished pockets each defined at least in part by upwardly and outwardly sloping side walls, the side walls between two adjacent pockets converging upwardly with each other to a zone of confluence and merging into a partition wall extending substantially vertically upwardly from the zone of confluence to a height substantially above the zone of confluence, the thickness of the partition wall being substantially uniform throughout the vertical extent thereof, and the density of the fibrous pulp material of the partition wall being substantially greater than the density of the fibrous pulp material of the pocket side walls.

2. A container molded of fibrous pulp material as in claim 1 wherein the fibrous pulp material of the partition wall is approximately twice the density of the fibrous pulp material of the pocket side walls.

3. A container molded of fibrous pulp material as in claim 1 wherein the uniform thickness of the partition wall is substantially the same as the thickness of each of the pocket side walls.

4. A container molded of fibrous pulp material as in claim 1 wherein the partition wall comprises two adjacent layers integrally joined to the pocket side walls at the zone of confluence.

5. A container molded of fibrous pulp material as in claim 1 wherein the length of the partition wall is less than the length of the side walls between two adjacent pockets.

6. A container molded of fibrous pulp material as in claim 5 wherein the partition wall extends higher than the adjacent pocket side walls at each end thereof and the adjacent pocket side walls are integrally joined together at their tops at each end of the partition wall.

7. A container molded of fibrous pulp material as in claim 6 wherein the partition wall comprises two adjacent layers integrally joined together along the top and at least part of the ends of the partition wall and is substantially the same thickness and approximately twice the density of each of the pocket side walls.

8. A container molded of fibrous pump material as in claim 1 wherein at least the central portion of the partition wall is of substantially uniform thickness horizontally lengthwise of the pocket side walls as well as throughout the vertical extent of the partition wall.

9. A container molded of fibrous pulp material as in claim 1 wherein the partition wall includes portions on each end of the central portion which are thicker than the central portion but which are still of substantially uniform thickness throughout the vertical extent of the partition wall.

10. An egg carton molded of fibrous pulp material comprising carton side and end walls, a plurality of integrally molded upwardly tapering and inwardly indented partial posts spaced at predetermined locations along the walls to in part define a plurality of downwardly dished egg pockets, a plurality of upwardly tapering hollow full posts located interiorly of the carton side and end walls to in part define the egg pockets, a plurality of pocket side walls integrally connected between the partial and full posts to further define the egg pockets, the pocket side walls between two adjacent pockets converging upwardly with each other to a zone of confluence and merging into an after-pressed partition wall extending substantially vertically upwardly from the zone of confluence through the zone of maximum girth of eggs positioned in the pockets, the thickness of the partition wall being substantially uniform throughout the vertical extent thereof, and the density of the fibrous pulp material of the partition wall being substantially greater than the density of the fibrous pulp material of the pocket side walls.

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