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SHOCK ABSORPTIVE PACKAGING CONSTRUCTION

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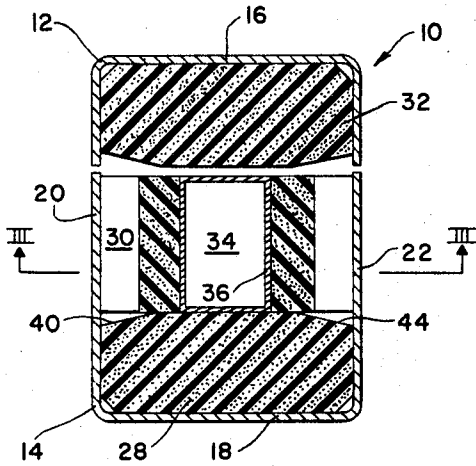


FIG. 1

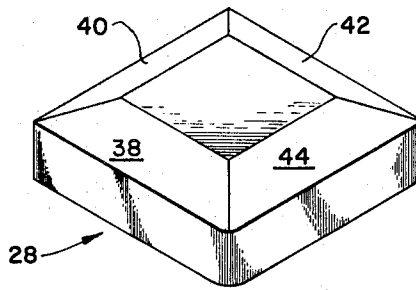


FIG. 2

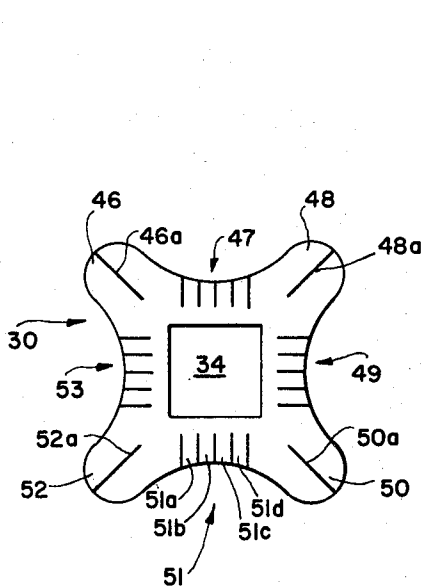


FIG. 3

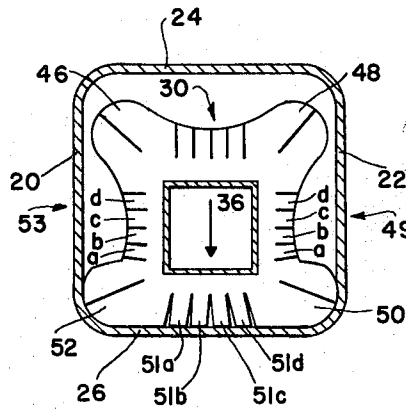


FIG. 4

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SHOCK ABSORPTIVE PACKAGING CONSTRUCTION

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ABSTRACT OF THE DISCLOSURE

A novel shock absorbing padding material and construction thereof for supporting an article within a container in spaced relation to the container side walls is provided whereby shock transmitted to the article, as a result of the container being dropped or subject to impacts, is greatly reduced. The padding, made of a resilient material, includes a plurality of finger portions extending outwardly toward the side walls of the container. When the container is dropped, the supported article causes the finger portions to be independently compressed against the side walls. This independent compression of the finger portions absorbs shock in an unusual manner to protect the article supported therein.

This invention relates to the packaging of delicate and fragile articles such as aircraft guidance instruments and the like, and more particularly to a new and unusual concept in such packaging which greatly reduces the shock transmitted to such an article as a result of dropping or otherwise impacting the package containing the article.

The problems associated with packaging delicate and fragile articles such as guidance instruments have existed for a long time in the past and have long been a source of considerable expense and frustration. Instruments which have been carefully constructed and calibrated frequently do not operate satisfactorily when actually received and installed, due to the magnitude and number of the jolts and shocks imparted to the instrument during shipping and handling of their containers. Further, instruments which have malfunctioned in one way or another during actual operation and which should be returned to the manufacturer in the same condition as when removed from an aircraft or the like, for determination of the cause of malfunction, are instead frequently returned with a multitude of other defects resulting from the severe shaking and high magnitude impacting imparted to the instrument during transit. Very often, the latter type of damage completely obscures the original cause of malfunction, so that suitable corrective measures may be impossible to determine.

Thus, for many years a variety of packages have been developed and experimented with which are intended to reduce the shock imparted to instruments and the like due to their containers having been dropped or otherwise jolted, and also for facilitating the repacking of an instrument after use for proper shipment back to its point of origin in a safe and undamaged condition. In essence, such previous efforts toward devising new packages utilized the concept of suspending the article to be packaged within a considerably larger containing structure, through the use of various types and forms of padding materials placed between the article and its enclosing outer package. Such padding was of varying degrees of resilience and of various shapes and dimensions, many specific forms of which were claimed to greatly reduce shock but none of which actually or satisfactorily accomplished this purpose, at least to the extent which was desired.

Thus, practice up to the present time involves the

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packaging of a relatively small instrument such as an indicator within a steel drum having a volume considerably larger than the size of the indicator itself. A typical such drum has a volume of 2.8 cubic feet and the instrument is packaged therein through the use of an extensive amount of bound fiber padding inserted on all sides between the indicator or other instrument and the inside walls of the drum. When tested by dropping such a container in freefall from a height of 30 inches, the average shock transferred to the instrument has been determined to be 47.6 G's, with some individual shock readings being in excess of 100 G's.

It is a major object of the present invention to provide a new concept in shock-absorptive packaging constructions which very greatly reduces the shock transmitted to the packaged instrument, by means of a packaging structure which is both smaller and lighter in weight than previous structures and which also greatly facilitates repackaging of the article for return to the manufacturer in the same condition as removed from the aircraft or other installation.

The reduction in shock transmitted to the packaged instrument or article obtained by the present invention are truly significant. Using the same tests indicated above for the steel drum package presently in use, the packaging construction of the present invention reduced the shock transmitted to a typical indicator to an average of 9.7 G's, with no individual shock being greater than 11 G's. This is well within the acceptable range for such an instrument, and the improved performance over previous packages is nothing less than startling.

The foregoing major objects and the advantages of the invention, together with other objects and advantages no less a part thereof, will become increasingly apparent following consideration of the ensuing specification and its appended claims, particularly when taken in conjunction with the accompanying illustrative drawings showing a preferred embodiment thereof.

In the drawings:

FIG. 1 is a side elevation in central section of the composite package construction;

FIG. 2 is a frontal perspective view showing details of a first component of the construction;

FIG. 3 is a cross-sectional view taken along the plane III—III of FIG. 1 particularly illustrating a second component of the construction; and

FIG. 4 is a cross-sectional view taken along the plane III—III of FIG. 1 showing the device undergoing deformation produced by dropping or impacting the case.

Briefly stated, the present packaging construction includes an outer case having a pair of end walls and lateral side walls which together provide an enclosing shell, and first, second, and third mutually independent tier sections of resilient padding material located within the shell and oriented in axial alignment between the end walls thereof. The middle or second tier section defines a centrally-located cavity of substantially the same size as an ordinary carton containing the article to be packaged, for receiving such carton and article therein. Further, the second tier section has a plurality of mutually independent finger portions extending outwardly toward the lateral sides of the shell. In operation, predetermined ones of the finger portions are independently and resiliently compressed against a portion of the side walls when the packaging construction is dropped or otherwise impacted in the direction of and upon such side wall portions to cause the article in said cavity to move in the direction of these side wall portions. The resilient independent compression of the said finger portions cushions and restricts the shock

in an unusual manner to protect the article located in the cavity.

Referring now in more detail to the drawings, the packaging construction 10 of the invention has an outer case or shell made up of cooperating halves 12 and 14 which may be secured together by desired latches or the like (not shown) to provide an integrated, unitary shell having end walls 16 and 18 and side walls 20, 22, 24, and 26 (FIGS. 1 and 4). The outer shell or case is preferably of a resilient, impact-resisting plastic of a known type, such as is manufactured by the U.S. Rubber Company and designated "Royalite #40."

Within the shell enclosure just described are three mutually independent tiers 28, 30, and 32 of resilient padding material which are aligned axially between end walls 16 and 18 of the shell and which extend laterally to contact the side walls 20, 22, 24, and 26 thereof. The padding material forming the tiers 28, 30 and 32 is preferably a light density synthetic foam, such as foamed polyurethane, and each of the tiers has a particular shape, which will be described more fully hereinafter. The first and third tiers 28 and 32, respectively, are identical in form and are symmetrically arranged on each side of the second tier 30. The latter has a centrally located open cavity 34, into which a suitable inner container 36 is inserted, for receiving the article which is to be packaged. The inner container 36 may be a cardboard carton or the like, and a size which is suited to closely contain the instrument or other article which is to be packaged. As will be noted, the cavity 34 is substantially of the same depth as the height of the inner container 36, and the cavity extends completely through the second or middle tier 30, whose height is substantially the same as that of the inner container 36. Consequently, the ends of the inner container are exposed at, but flush with, each side of the second tier.

The first and third or end tiers 28 and 32, respectively, are identical, and are illustrated in FIG. 2. These components are preferably a single block of foamed polyurethane, and they have a length and width comparable to that of the interior of the outer case of shell, so that they may be placed into the shell with their four sides immediately adjacent the sides 20, 22, 24, and 26 of the shell without compressing the tier section. Further, the first and third or end tiers have a vertically elongated width or thickness at their central portions. This is produced by the bevelled surfaces 38, 40, 42, and 44, seen in FIGS. 1 and 2. This provides a central plane surface which contacts one end of the inner carton 36 and the central portion of the second or middle tier 30 as well, while providing a definite clearance space between the lateral edges of the middle and end tiers near the lateral sides such as 20 and 22 of the outer case or shell.

The middle or second tier 30 is basically flat on its top and bottom surfaces, i.e., this member has a substantially uniform thickness. As seen in FIG. 3, however, the lateral or side surfaces of this tier section are of an unusual configuration. Each corner 46, 48, 50, and 52 of this member is shaped to provide a rounded projecting leg which extends outwardly from the central cavity 34 and whose ends normally lie immediately adjacent the inside corners of the outer shell or case. Further, each of the corners 46, 48, 50, and 52 are bifurcated by a slit or cut 46a, 48a, 50a and 52a, respectively, which extends toward but does not reach the corners of the inner cavity 34.

The rounded corner legs of second tier 30 are interconnected by smoothly curved side edges 47, 49, 51, and 53, each of which are divided by a series of slits or cuts which extend inwardly from one of the curved edges, toward the sides of the cavity 34, over a major portion of the distance therebetween. The said slits or cuts do not extend into the cavity, however, but instead are terminated so that the mutually independent finger portions such as 51a, 51b, 51c, and 51d provided by the cuts

have a common connection in the area adjacent the edge of the inner cavity 34. Each of the cuts forming the aforesaid finger portions is preferably made by a saw blade, and consequently has a finite thickness. Thus, the finger portions are actually slightly spaced from each other, even in the normal or relaxed and unstressed configuration illustrated in FIG. 3.

Exemplary specific dimensions for a particular packaging construction designed for an instrument weighing approximately eight to twelve pounds and requiring an inner carton which is 5½ x 5½ x 8 inches are as follows. The end tiers 28 and 32 are 15 x 15 x 6 inches and the bevels such as 38, 40, 42, and 44 reduce the thickness of 6 inches at the center to about 5 inches at the sides. The overall size of the second tier 30 is 15 x 15 x 8 inches, with the radius of curvature of the extending legs 46, 48, 50, and 52 being about 2 inches and the radius of curvature of side surfaces 47, 49, 51, and 53 being about 6 inches, so that the dimension between any side of the cavity 34 and the corresponding curved side surface is approximately 3 inches. The cuts forming the fingers extend from the curved side surfaces to within about 1 inch of the cavity 34.

As may be observed from FIG. 1, packaging and re-packaging of an instrument or other fragile article is extremely easy and fast. All that need be done is to first insert the first and second tiers 28 and 30, respectively, into one of the halves of the outer shell, such as the bottom half 14; then place instrument in the inner container 36 and insert this into the inner compartment 34 of the second tier; then place the third or upper tier 32 atop the second tier 30 and its inner carton 36; and finally place the second half or top 12 of the outer shell over the upper tier and secure it to the bottom half of the shell.

Under dynamic (shock-absorbing) conditions, the operation and performance of the novel packaging construction is as follows. When the assembled package is dropped on either end wall 16 and 18, the inner container 36 and its contents are cushioned by the bevelled protruding portions of the first or third tiers, and thus protected from shock. When the carton is dropped on any sidewall, such as for example sidewall 26 (FIG. 4) the inner carton 36 is moved in the direction indicated by the arrow, i.e., toward sidewall 26. The inner or second tier 30 absorbs the shock produced in this manner through a pattern of deformation such as is indicated in FIG. 4. Initially, the inertia of the inner carton 36 displaces the position of the cavity 34 to a position closer to sidewall 26, in which all of the second tier is to some extent moved toward this sidewall through the compression of the lower extremity of this tier. This causes the two upper laterally-extending legs 46 and 48 to be moved out of the corners of the outer shell which they previously occupied, and the two lower legs 50 and 52 are pressed tightly into the corners of the shell which they occupy. Next, the arcuate tier surface 51 becomes straightened to conform to the inner surface of outer shell sidewall 26 as lateral legs 50 and 52 undergo what is basically a compressive stress. This necessarily increases the separation between each of the finger portions 51a, 51b, 51c, and 51d, and brings each of these finger portions into independent contact with shell sidewall 26.

As the impacting force of dropping the package continues, each of the finger portions begins to act as an independent stress-absorbing compressive column, while that portion of the tier 30 interconnecting these finger portions with extending legs 50 and 52 undergoes a complex stress including both bending and compressive components, as is also true of the leg portions 50 and 52. Also, as legs 50 and 52 are pressed into their respective corners of the outer shell and curved surface 51 is straightened, the portion of curved surfaces 49 and 53 adjacent legs 50 and 52, respectively, are deformed by a predominantly compressive stress, such that independent finger portions 49a and 49b and 53a and 53b are compressed sideways

against finger portions 49c and 49d, and 53c and 53d, respectively. (It may be that finger portions 49c and 49d, and fingers 53c and 53d are also compressed and deformed to a lesser extent, although this is not discernible to the naked eye under simulated test conditions.)

The results of this complex stress and deformation situation are a great reduction in the stress imparted to the article in the inner carton 36 from the impacting or dropping of the container, by amounts which have been indicated above. As will be apparent, it is very difficult to quantitatively analyze the exact reasons why the structure of this invention gives such greatly improved performance, but the performance is measureable under test, and the greatly improved results have definitely been ascertained.

Packages utilizing the novel construction described hereinabove provide a number of very significant advantages. The foremost one of these is, of course, the great reduction in shock transmitted to a packaged article. Additionally, however, the resulting package is significantly smaller than previous packages of the steel drum type, and weighs less than the latter. Shipping costs are reduced by a factor of twenty-eight percent savings in the cost of repairs to an article due to damage incurred in transit. Finally, and very significantly, packages utilizing the present construction afford a savings of approximately fifty percent in labor costs for packing instruments or other fragile articles within the container.

It is quite conceivable that upon considering the foregoing disclosure, others skilled in the packaging arts discover for themselves different embodiments of the underlying concept here involved, or may devise certain modifications and variations of the specific structure shown and described herein. All such further modifications, variations, and changes in structure as clearly incorporate the concept of the invention are thus to be considered as within the scope of the claims appended herebelow, unless these claims by their language specifically state otherwise.

I claim:

1. In a shock-absorptive packaging construction of the type having an enclosing exterior shell and interior padding sections for supporting an article within said shell relative to its ends, the improvement comprising a padding structure for supporting the article in spaced relation relative to at least one side of the shell; said padding structure having a surface for contacting said article and having a plurality of legs extending outwardly in a direction away from said surface toward said side of the shell and a plurality of fingers located between said legs, said legs normally contacting said side of said shell and said fingers normally terminating short thereof; said legs and fingers restricting the shock to such article due to dropping by said fingers being independently resiliently deformed when the packaging construction is dropped or otherwise impacted.

2. The packaging construction of claim 1, wherein the locus of the end extremities of each of the said fingers located between each two of said legs defines a regular curve extending between such two legs.

3. The improvement in packaging constructions defined in claim 1, wherein at least some of said fingers are arranged in lateral alignment in at least one plane area containing portions of the sides of said shell, and wherein the fingers in each such plane have a mutual interconnection in the area near said article but are distinct and at least slightly spaced from each other as they extend outwardly toward the sides of said shell.

4. The improvement in packaging constructions defined in claim 1, in which said padding structure extends along several sides of said shell and forms an internal cavity for receiving an article to be supported.

5. The improvement in packaging construction as defined in claim 4 in which said cavity is open at at least

one end and at least one other resilient padding member is provided for contacting and supporting the article to be supported.

6. The improvement in packaging construction as defined in claim 4 in which said cavity is open in opposite ends and two resilient pads are provided, one at each opening, for contacting and supporting the article to be supported.

7. The improvement in packaging constructions defined in claim 2, in which said padding structure extends along several sides of said shell and forms an internal cavity for receiving an article to be supported.

8. The improvement in packaging construction as defined in claim 7 in which said cavity is open at at least one end and at least one other resilient padding member is provided for contacting and supporting the article to be supported.

9. The improvement in packaging construction as defined in claim 8 in which said cavity is open in opposite ends and two resilient pads are provided, one at each opening, for contacting and supporting the article to be supported.

10. The improvement in packaging constructions defined in claim 1, wherein said padding construction is formed by a resilient having of material having slits cut in the fingers of the padding adjacent said shell; said slits extending toward said article-contacting surface and terminating short of said surface.

11. The improvement in packaging constructions defined in claim 2, wherein said padding construction is formed by a resilient having of material having slits cut in the fingers of the padding adjacent said shell; said slits extending toward said article-contacting surface and terminating short of said surface.

12. The improvement in packaging constructions defined in claim 3, wherein said padding construction is formed by a resilient piece of material having slits cut in the fingers of the padding adjacent said shell; said slits extending toward said article-contacting surface and terminating short of said surface.

13. The improvement in packaging constructions defined in claim 12, in which said padding structure extends along several sides of said shell and forms an internal cavity for receiving an article to be supported.

14. The improvement in packaging construction as defined in claim 13 in which said cavity is open at at least one end and at least one other resilient padding member is provided for contacting and supporting the article to be supported.

15. The improvement in packaging construction as defined in claim 14 in which said cavity is open in opposite ends and two resilient pads are provided, one at each opening, for contacting and supporting the article to be supported.

16. In a shock-absorptive packaging construction of the type having an exterior shell and interior padding for supporting an article within said shell relative to its ends, the improvement comprising a padding structure for supporting the article in spaced relation relative to the sides of the shell; said padding structure having a surface for contacting said article and having a plurality of legs extending outwardly from said supporting surface toward said sides of said shell, and a plurality of fingers located between said legs; said legs normally contacting said sides of said shell and said fingers normally terminating short thereof; whereby shocks transmitted to such article are restricted by said fingers being independently resiliently deformed when the shell is dropped or otherwise impacted.

17. In a shock-absorptive packaging construction of the type having an exterior shell and interior padding for supporting an article within said shell relative to its ends, the improvement comprising a padding structure

having a surface for supporting the article in spaced relation relative to a side of the shell; said padding structure having a plurality of legs extending toward said side of said shell and a plurality of fingers located between said legs extending toward said shell and normally terminating short thereof; said legs and fingers being independently resiliently deformable such that when the shell is dropped or otherwise impacted shocks transmitted to said supported article are restricted. 5

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RAPHAEL H. SCHWARTZ, *Primary Examiner.*