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PACKAGING MEANS
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FIG. 1.

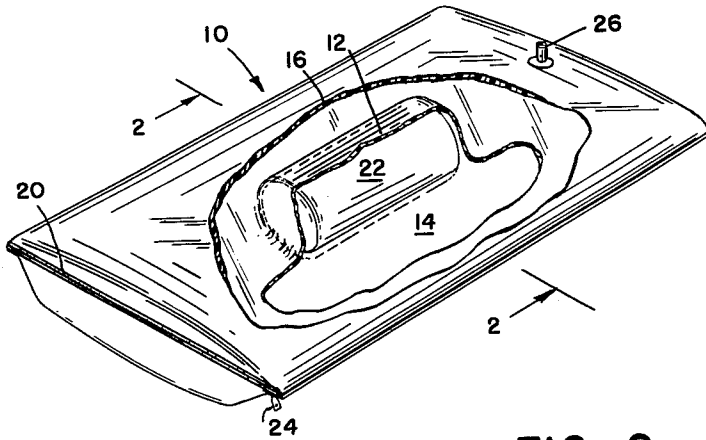
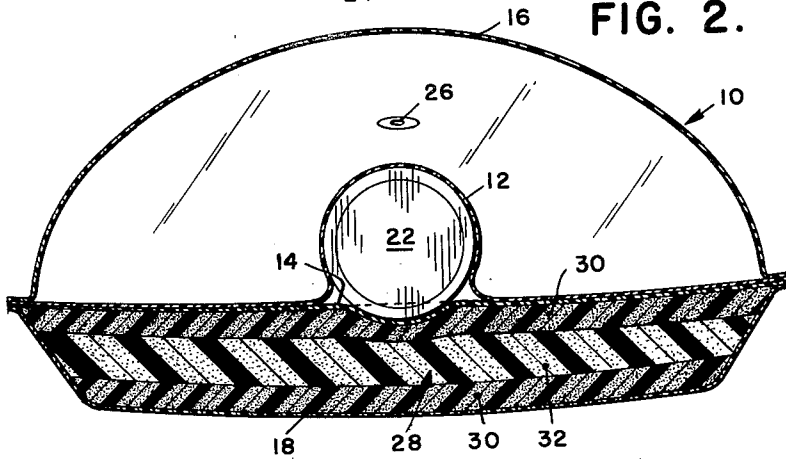


FIG. 2.



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PACKAGING MEANS

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This invention relates to packaging means, and more particularly to a packaging envelope or bag wherein pressurized gas is used in combination with a cushioning material to provide complete protection for the part packaged.

The present invention is particularly applicable to the packaging of fragile industrial parts, such as electrical and electronic parts, which are especially susceptible to damage. Damage can occur from rough handling or accidental dropping of these parts during shipment or storage. Many packaging methods and devices for such parts have been previously proposed. The most common method is to simply surround the parts with cushioning materials of various sorts, such as excelsior, shredded paper, rubberized hair, and foam rubber or plastic, in what is deemed to be a sufficient quantity to provide protection against the anticipated impact forces. Generally, because of the desire to be on the safe side, this practice results in a final shipping pack which is many times the size of the object packaged. Such liberal use of cushioning material entails unnecessary expense for the cushioning material and for shipping because of the larger size pack.

Another common practice is to make a special package for the part, especially for those parts having irregular surfaces. Here, the cushioning material, which is usually foam, is cut and shaped to conform to the external configuration of the part. Needless to say, the design and fabrication of these special packages are time consuming and expensive.

Accordingly, it is a general object of the present invention to provide a packaging means which is economical, compact and yet will provide complete protection for the part during shipment, storage, and handling.

It is another object of the present invention to provide a packaging bag or envelope wherein the part is made integral with the cushioning means so that there is no relative movement of the part with respect to said means.

It is another object of the present invention to provide a packaging bag or envelope which is transparent so that the part is readily visible for inspection without removal from the bag.

It is another object of the present invention to provide a packaging bag or envelope which is sealed to prevent the entry of moisture, dirt, and other contaminants which may corrode or damage the part.

Generally stated, the present packaging means comprises a plastic envelope or bag which has an object-receiving, or first, compartment and a fluid-tight, or second, compartment sharing a common wall with the first compartment, and a third compartment adjacent to the first compartment and containing a cushioning material, preferably of foam. After the object or part being packaged has been placed more or less centrally in the first compartment, a gaseous fluid, such as nitrogen or air, is introduced into the second compartment. The fluid not only serves as a cushion for the part, but it also skin packs the part and prevents it from moving within the package itself. This unique combination of a fluid cushion and a foam cushion protects the part against impact shock, vibration forces encountered during shipment, and rough handling.

Other features and advantages of the present invention will become apparent from the following detailed descrip-

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tion of a typical embodiment of the invention taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a perspective view of a packaging envelope embodying the present invention, with certain portions broken away to show the internal construction; and

FIGURE 2 is a sectional, elevational view of the packaging envelope taken along the line 2—2 of FIGURE 1.

FIGURES 1 and 2 show a generally rectangular envelope 10 of the present invention having an object-receiving compartment constituted of walls 12, 14, a fluid-tight compartment constituted of walls 12, 16, and a cushion compartment constituted of walls 14 and 18. These walls are made of flexible plastic films and are heat-sealed at the edges to form the respective compartments. To facilitate identification and inspection of the object 22 to be packaged, walls 12 and 16 are preferably made of a transparent plastic, such as clear vinyl. Walls 14 and 18 may be made of transparent or pigmented film, as desired. The object-receiving compartment has an opening 20 at one end for insertion of object 22. Opening 20 is provided with closure means, such as a plastic zipper 24, to prevent the entry of dust, dirt, and other contaminants into the compartment. The fluid-tight compartment is provided with suitable means for introducing a gaseous fluid therein, such as a Robert's air valve 26 in wall 16. The cushion compartment contains a plastic foam cushion, generally designated as 28.

After insertion of object 22 into envelope 10, the fluid-tight compartment is filled through valve 26 with a gaseous fluid, such as nitrogen or air, under a pressure of about 1 to 4½ pounds per square inch, depending upon the weight of the object. The fluid pressure distends wall 16 and causes wall 12 to hug or skin pack object 22 in rough conformity to its shape. Object 22 is thereby held firmly against foam cushion 28 so that it is not free to move in any direction. Thus, the object and the air and foam cushions are in effect made integral, and there is no relative movement between them while the package is being shipped or handled or upon drop impact of the package.

Another advantage of this immobility of the object is that the object is prevented from engaging in a whipping action within the package during shipment. This action frequently occurs in previously known packaging means wherein an object is entirely surrounded with a resilient foam material and vibration exciting frequencies are encountered during shipment which cause increasingly large amplitudes of the object within the package. If these vibrations are not damped, they may lead to a physical breakdown of the cushioning material which would reduce its cushioning effectiveness or lead to actual damage of the part by contact with the exterior shipping container. By making the object integral with the cushioning means, the present packaging envelope materially damps such vibratory motions and prevents any damage to the part from this source.

Foam cushion 28 comprises a sandwich construction of two different foam materials. External foam layers 30 are constituted of a closed cell polyethylene foam having a density of from 1.8 to 2.2 pounds per cubic foot. Internal foam layer 32 is constituted of a flexible, open cell polyurethane foam having a density of from 0.7 to 5 pounds per cubic foot. The polyurethane foam, being resilient, decreases the deceleration forces encountered by the object upon impact. The polyethylene layer closest to the object serves as a supporting platform for the object when fluid pressure is applied. Without such a platform, the polyurethane layer may become overly compressed and thus lose much of its shock reducing effectiveness. The polyethylene layer farthest removed from the object, as well as the previously mentioned layer, absorb the im-

compact forces and thereby prevent them from being transmitted to the object.

Although a particular combination of foam cushioning materials has been described, it will be apparent to those skilled in the art that other foam materials, such as polystyrene and vinyl foams, may be used either singly or in combination. Also, the exact thickness and bearing areas of the cushioning material to be used for a given application can be determined by knowing the fragility or G-factor of the object (one G equalling the acceleration due to gravity) and by using relevant data supplied by the manufacturers of the cushioning materials.

Another method for determining the required foam thickness would be to conduct dynamic tests on a given foam material. In these tests, a series of known weights are dropped from varying heights onto a pad of the cushioning material of a given area and thickness. The amount of shock encountered by the weights is detected by an accelerometer attached to the weights, which sends an electrical impulse proportional to the shock to an oscilloscope screen. By appropriate calibration of the screen, the deceleration of the weights can be read directly in G forces (one G equalling the acceleration due to gravity). Thus, a cushion which was found to produce a deceleration of 10 G's on a given weight from a given height would be adequate for cushioning an object of the same weight and bearing area for an anticipated fall of the same height. Appropriate adjustments in cushion thickness are made for the bearing area of the object. For those objects having a larger bearing area than the test weight, the cushion thickness may be reduced and for those objects having a smaller bearing area than the test weight, the cushion thickness is proportionately increased.

By utilizing the above-described dynamic test procedure, the maximum required thickness for previously described foam cushion 28 was found to be about one foot, evenly divided into the three layers, for objects having a G-factor of from 10 to 25, a bearing surface of 110 to 144 square inches, and a weight of 16 to 40 pounds and an anticipated drop height of 48 inches. Since many electronic parts are considerably lighter and smaller in size, it will be apparent that the present packaging envelope is relatively compact compared to those previously known. Thus, these parts may be retained in the present packaging envelope until they are ready for final use.

The following are three specific examples of the present packaging envelope which will further illustrate the unique features and advantages provided by the present invention.

Example I

In this application, a cathode ray tube weighing approximately 21 pounds and having a maximum side or bearing area of about 90 square inches and a fragility factor, or G-factor, of 20 was enclosed in a rectangular packaging envelope having sides of approximately 18 and 24 inches. The outer wall of the fluid-tight compartment, represented in FIGURE 1 by 16, was made of 16 mil, clear, semi-rigid vinyl film and the inner wall, represented in FIGURE 1 by 12, was made of 8 mil, clear, flexible vinyl film. The walls of the foam compartment, represented by 14 and 18 in FIGURE 1, were made of 10 mil, pigmented, semi-rigid, vinyl film. The foam cushion, represented generally by 28 in FIGURE 2, was a sandwich construction consisting of external layers 30 of 1½ inch thick, closed cell, polyethylene foam having a density of 1.8 to 2.2 pounds per cubic foot and of an internal layer of 3 inch thick, open cell polyurethane foam having a density of about 4 pounds per cubic foot.

The fluid compartment was inflated with nitrogen at a pressure of 3 pounds per square inch and the package was then put into a 200 pound test corrugated (regular slotted) shipping carton having the dimensions 24 inches by 18 inches by 12 inches. An accelerometer was attached to

the part and connected to an Impact-a-graph, an instrument measuring and recording acceleration forces. The package was then subjected to a 36 inch drop on each face and on each end. It was found that the maximum "G" load transmitted to the part was 17 G's and that there was no damage to the part.

Example II

In this application, an Impactron, a mechanical shock indicating device manufactured by Data Science Corporation of San Diego, California, was inserted into a square packaging envelope having 8 inch sides. The Impactron weighed approximately ¼ pound and had a bearing area of about 1.5 square inches and a G-factor of 15. The outer wall of the fluid-tight compartment, represented in FIGURE 1 by 16, was made of 10 mil, clear, semi-rigid vinyl film and the inner wall, represented in FIGURE 1 by 12, was made of 8 mil, clear, flexible vinyl film. The walls of the foam compartment, represented by 14 and 18 in FIGURE 1, were made of 10 mil, pigmented, semi-rigid, vinyl film. The foam cushion in this case was made of open cell polyurethane foam, 4 inches thick, and having a density of about 0.7 pounds per cubic foot.

After the fluid compartment was inflated with nitrogen at a pressure of 1.5 pounds per square inch, the package was dropped from heights of 12, 18, and 24 inches upon a concrete slab. The maximum "G" load imposed on the part was found to be 13 G's, and the part was undamaged.

Example III

In this application, an electronic device weighing about 10 pounds and having a bearing area of 72 square inches and a G-factor of 30 was enclosed in a rectangular packaging envelope having sides of approximately 10 and 12 inches. The outer wall of the fluid-tight compartment, represented in FIGURE 1 by 16, was made of 16 mil, clear, semi-rigid vinyl film and the inner wall, represented in FIGURE 1 by 12, was made of 8 mil, clear, flexible vinyl film. The walls of the foam compartment, represented by 14 and 18 in FIGURE 1, were made of 10 mil, pigmented, semi-rigid vinyl film. The foam cushion, represented generally by 28 in FIGURE 2, was a sandwich construction consisting of external layers 30 of 1¾ inch thick, closed cell, polyethylene foam having a density of 1.8 to 2.2 pounds per cubic foot and of an internal layer of 2 inches thick, open cell polyurethane foam having a density of about 4 pounds per cubic foot.

The fluid compartment was inflated with nitrogen at a pressure of about 2½ pounds per square inch and the package was then put into a 175 pound test corrugated (regular slotted) carton. An Impactron, rated to trip at 30 G's load, was then attached to the package and the complete pack was subjected to 6 successive drops from a height of 48 inches, once on each face of the carton. Upon completion of the drops, the device was inspected and found to be undamaged. The Impactron was not tripped.

Thus, the present invention provides for a packaging means which is relatively compact and yet will provide complete protection for the part.

Although particular embodiments of the invention have been illustrated and described, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from the invention, and it is intended to cover in the appended claims all such modifications and equivalents as fall within the true spirit and scope of this invention.

I claim:

1. A plastic packaging envelope comprising: a first compartment having an entry for the object to be packaged; means for sealing said entry; a fluid-tight, second compartment, said compartment having flexible walls, one of which being common to said first and second compartments; a third compartment adjacent to the first compartment; a foam cushion in the third compartment,

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said cushion being comprised of outside layers of a closed cell polyethylene foam and an intermediate layer of an open cell polyurethane foam, said layers being in sandwich arrangement; valve means for introducing a gaseous fluid into the second compartment, said fluid being effective to cause said common wall to skin pack said object and thereby hold said object immobile against the foam cushion.

2. An envelope according to claim 1, wherein the polyethylene foam has a density of from 1.8 to 2.2 pounds per cubic foot and the polyurethane foam has a density of from 0.7 to 5 pounds per cubic foot.

3. An envelope according to claim 1, wherein the gaseous fluid is at a pressure of from 1 to 4.5 pounds per square inch.

4. A plastic packaging envelope comprising: a first compartment having an entry for the object to be packaged; means for sealing said entry; a fluid-tight, second compartment, said compartment having flexible walls, one of which being common to said first and second compartments; a third compartment adjacent to the first compartment; a foam cushion in the third compartment; valve means for introducing a gaseous fluid into the second compartment, said fluid being effective to cause said common wall to skin pack said object and thereby hold said object immobile against the foam cushion.

5. A plastic packaging envelope comprising: an object-receiving, first compartment; a fluid-tight, second compartment, said compartment having a common wall with the first compartment; a third compartment adjacent to the first compartment; a foam cushion in the third compartment; said foam cushion comprising a sandwich arrangement of external layers of a semi-rigid foam and an internal layer of a flexible foam; means for introducing a gaseous fluid into the second compartment, said fluid being effective to cause said common wall to skin pack the object contained in said first compartment and thereby immobilize said object.

6. An envelope for packaging fragile objects comprising: an object-receiving, first compartment; a fluid-tight, second compartment on one side of said first compartment; a third compartment on the other side of the first compartment; said first, second, and third compartments being comprised of plastic film materials interconnected at the edges to form the respective compartments; an impact shock absorbing cushioning material in the third compartment; means for introducing a gaseous fluid into the second compartment for skin packing the object contained in said first compartment against the cushioning material and thereby rendering it immobile within the first compartment.

7. An envelope for packaging fragile objects comprising: a first compartment having an entry for the object; means for sealing said entry; a fluid-tight, second compartment on one side of the first compartment; a third compartment on the other side of the first compartment; said first, second, and third compartments being comprised of vinyl films heat-sealed together at the edges to form the respective compartments; an impact shock absorbing cushioning material in the third compartment; means for introducing a gaseous fluid into the second compartment for skin packing the object contained in said first compartment against the cushioning material

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and thereby rendering it immobile within the first compartment.

8. A plastic packaging envelope comprising: an object-receiving, first compartment; a fluid-tight, second compartment, said compartment having a common wall with the first compartment; a third compartment adjacent to the first compartment; a cushioning material in the third compartment, said material comprising an open cell polyurethane foam having a density of from 0.7 to 5 pounds per cubic foot; means for introducing a gaseous fluid into the second compartment, said fluid being effective to cause said common wall to skin pack the object contained in said first compartment, whereby the object is immobilized within said envelope.

9. A plastic packaging envelope comprising: an object-receiving, first compartment; a fluid-tight, second compartment, said compartment having a common wall with the first compartment; a third compartment adjacent to the first compartment; a cushioning material comprising a closed cell polyethylene foam having a density of from 1.8 to 2.2 pounds per cubic foot; means for introducing a gaseous fluid into the second compartment, said fluid being effective to cause said common wall to skin pack the object contained in said first compartment, whereby the object is immobilized within said envelope.

10. A plastic packaging envelope comprising: an object-receiving, first compartment; a fluid-tight, second compartment, said compartment having a common wall with the first compartment; a third compartment adjacent to the first compartment; a cushioning material comprising external layers of a closed cell polyethylene foam having a density of from 1.8 to 2.2 pounds per cubic foot and an intermediate layer of an open cell polyurethane foam having a density of from 0.7 to 5 pounds per cubic foot, said layers being in sandwich arrangement; means for introducing a gaseous fluid into the second compartment, said fluid being effective to cause said common wall to skin pack the object contained in said first compartment, whereby the object is immobilized within said envelope.

11. An envelope for packaging fragile objects comprising: an object-receiving, first compartment; a fluid-tight, second compartment; said first and second compartments being comprised of flexible plastic film materials interconnected at the edges forming the respective compartments; an impact shock absorbing foam cushion contained in the envelope resiliently supporting the object within said first compartment; means for introducing a gaseous fluid into the second compartment for skin packing the object contained in said first compartment against the foam cushion and thereby rendering it immobile within the first compartment.

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