Jan. 25, 1966 R. J. WILLIAMS 3,231,454

CUSHIONING MATERIAL

Filed April 14, 1961

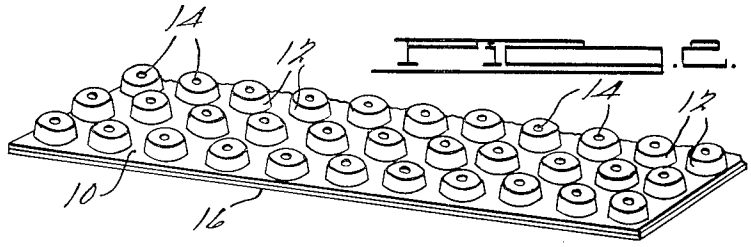


FIG. 2.

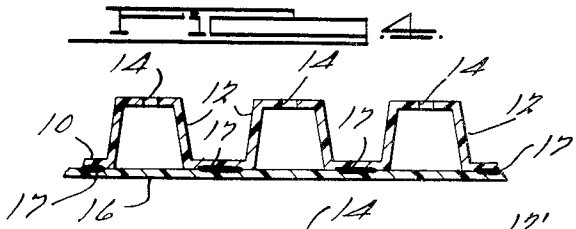
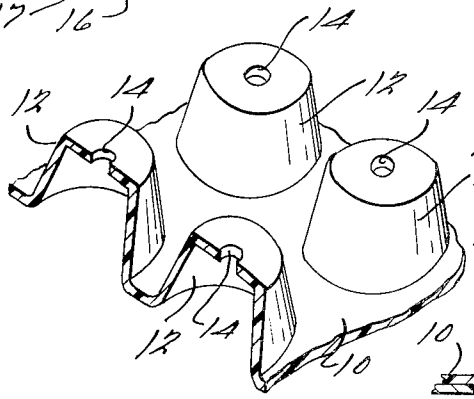


FIG. 4.



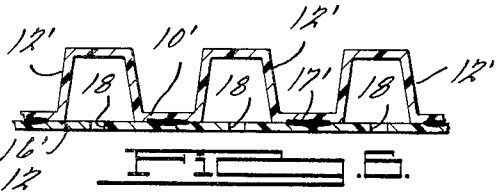


FIG. 6.

FIG. 1.

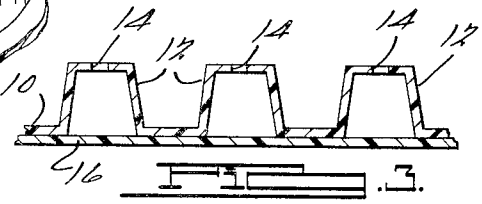


FIG. 3.

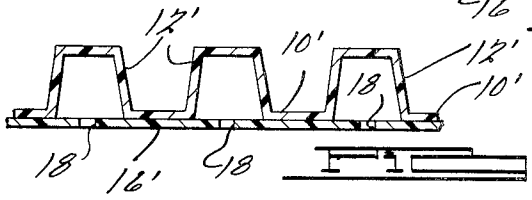


FIG. 5.

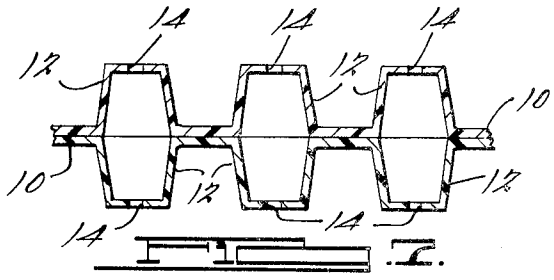


FIG. 7.

INVENTOR.
Robert J. Williams.
BY
Thomas, Dickey & Pierce.
ATTORNEYS

United States Patent Office

3,231,454

Patented Jan. 25, 1966

3,231,454

CUSHIONING MATERIAL

Robert Joseph Williams, Birmingham, Mich., assignor to Cadillac Products, Inc., Warren, Mich., a corporation of Michigan

Filed Apr. 14, 1961, Ser. No. 103,144
2 Claims. (Cl. 161—110)

This invention relates generally to packaging, and more particularly to a novel cushioning material for lining containers or otherwise insulating fragile articles from vibration, physical abuse and shock during handling and the like.

The primary objects of the present invention reside in the provision of a novel and inexpensive cushioning material for the above purpose formed of either one or a plurality of sheets of resilient material, at least one sheet of which is so constructed that uniform static and dynamic cushioning may be effected both by the compressive columnar loading of hollow columnar-shaped projections formed therein and by the pneumatic shock absorbing effect of air trapped within these projections, the latter being provided with vent openings through which the air may pass when a sudden or shock load is applied thereto, whereby fragile or highly finished articles encased thereby will be cushioned and protected or insulated from physical shock, whether disposed within a container or not.

These and other objects of the present invention will become apparent from consideration of the specification taken in conjunction with the accompanying drawing, in which there are shown several embodiments of the invention by way of example, and wherein:

FIGURE 1 is a fragmentary perspective view, partly in section, illustrating the basic element of a cushioning material embodying the principles of the present invention;

FIGURE 2 is a perspective view of a multi-layer modification or adaptation of the cushioning material of the present invention;

FIGURE 3 is a transverse sectional view of the modification illustrated in FIGURE 2;

FIGURE 4 is a transverse sectional view illustrating a further modification of the cushioning material of the present invention;

FIGURES 5 and 6 are transverse sectional views illustrating slightly modified versions of the embodiments illustrated in FIGURES 3 and 4, respectively; and

FIGURE 7 is yet another modification or embodiment of the present invention.

Generally speaking, the cushioning material of the present invention comprises at least one sheet of resilient material having a plurality of hollow projections formed therein and projecting outwardly from one side of the sheet in the same direction, the sheet in the preferred embodiment having a plurality of vent openings therethrough, each of the vent openings being disposed at the outwardly projecting end of one of the projections. As will become apparent, a large number of modifications of the invention are possible by combining one or more sheets of this specific construction in various ways with other sheets, either similarly constructed or simply flat, and by relocating the vent openings therein. Further modifications may be derived either by sealing the individual sheets of a multi-sheet embodiment together, by not sealing these several sheets together, or by using sheets

of resilient thermoplastic film material of the type characterized by its retention of a high static charge, whereby the sheets will be attracted to each other by their retained static charges, all as will be more clearly set forth hereinafter.

Referring more particularly to the drawings, there is illustrated in FIGURE 1 a cushioning liner comprising a specially formed sheet of resilient material 10 embodying the principles of the present invention which may be used alone as a very satisfactory cushioning material, or which, as will be described later, may be used in combination with other sheets or layers of material in various combinations to form other embodiments of the invention. As can be seen, sheet 10 is provided with a plurality of hollow projections 12, each of which in this embodiment is of equal size and shape, all of the projections extending in the same direction from the same upper side of sheet 10. Each of the projections 12 is illustrated as being generally frusto-conical in shape so that they may be readily drawn from a suitable forming die. The provision of such draw, however, is not essential to the function of the cushioning element and is primarily for the purpose of facilitating fabrication, although some taper is helpful in increasing the stability of the projections by giving them wider bases. In order to obtain the desired compressive column loading of the sheet material itself the projections are preferably of a generally cylindrical or of steep right frusto-conical shape, and projections having these shapes will be referred to herein as being columnar-shaped.

In order to insure that air may escape from the projections in applications where the sheet 10 is used in conjunction with another surface contacting the bottom side thereof there is provided a bleed or vent opening 14 through the outwardly projecting end of each of the projections. As will be appreciated, vent openings 14 may be formed during the fabrication of the projections themselves, as by means of a suitable die punch or the like.

In order to more clearly understand the manner in which the cushioning liner functions, assume for purposes of explanation it is disposed on the flat bottom of a container and that there is resting thereon and supported thereby an article to be cushioned. When the container is at rest and the compressive loading of the cushioning liner is purely static, the article will be supported by the column strength of the sheet material defining each of the hollow projections. The resilience, strength, and thickness of the sheet from which it is formed may be chosen so that for a given weight to be supported per unit area of the cushioning material the projections will be slightly compressed or collapsed whereby a cushioning or spring effect will be obtained. When this container in which the cushioning material is provided is handled, or dropped, or otherwise subjected to jolts or physical shock, the impact loading of the projections will cause them to collapse or compress and to tend to flatten out. The air trapped within each of the air pockets defined between the cushioning material and the container by the projections will act as shock absorbers to absorb these impact loads, the vent openings 14 serving as restricting orifices to limit the flow of air from the air pockets so that the shock may be absorbed. While such vent openings may not be necessary in applications where the bottom side of sheet 10 is in contact with very porous material, such as porous paper, cardboard, or the like, in applications where a relatively non-porous material is provided in contact with

the bottom surface thereof the vent openings are essential to get the desired shock absorbing characteristics.

As will be appreciated, there are presently available a large number of different types of relatively inexpensive sheet material which lend themselves ideally to use with the present invention. The more important criteria for a suitable material from which cushioning material according to this invention may be formed would include resilience, a capacity to be molded or formed into a shape, a capacity to retain its shape and to return to its shape when deformed (i.e., memory), resistance to rupturing, low porosity so as to retain air, and so on. It has been found that a number of thermosplastic films meet these criteria, such as for example polyethylene, polypropylene, polyvinyl acetate, polyvinylidene chloride, and the like. The material, of course, must be such that it may be easily and economically formed into the desired shape. As will be more fully apparent hereinafter, other properties will be important in other specific modifications of the invention. For example, if a thermoplastic material is used, heat sealing may be readily used to join together several sheets to form a multi-layer embodiment of cushioning material. Alternately, if a film material of the type characterized by its retention of a high static charge is utilized, a plurality of sheets of such material may be combined into a multi-layer embodiment simply by means of the attraction of the sheets one for another by their retained static charges.

The essence of the invention lies, therefore, in the provision of a resilient sheet meeting the above criteria and having a plurality of projections therein, each of which is provided with a vent opening. However, as mentioned, one of these sheets may be used in a number of different ways in various cushioning applications. Accordingly, the remainder of the specification and drawing disclose several of these exemplary modifications.

Thus, there is illustrated in FIGURE 2 an embodiment of the present invention wherein a specially formed sheet **10** is used in conjunction with a second sheet or layer of material **16** positioned in contact with the lower surface of sheet **10**. Preferably sheet **16** is either of a similar or of the same material as that from which sheet **10** is formed, and serves the purpose of positively defining air pockets within the hollowed out portions of projections **12**. Sheets **10** and **16** may be either loosely contacting each other, as shown in FIGURE 3, or secured together in any one of a number of ways. For example, in FIGURE 4 there is illustrated an embodiment wherein sheets **10** and **16** are secured together by means of conventional heat seals **17**. These heat seals may be so arranged as to seal the two sheets together all the way around the periphery of each of the recesses formed in the lower side of sheet **10** by projections **12**, or just partially therearound. It is not essential that a completely sealed air pocket be formed, so long as there is some resistance to the escape of air therefrom, whereby the desired pneumatic cushioning effect may be obtained. Alternately, if a film material of the type characterized by the retention of a high static charge is utilized, the two sheets will be attracted together throughout most of their contacting surfaces by their retained static charges, as shown in FIGURE 3. Furthermore, the two sheets may be joined to one another, at spaced points or throughout their contacting surfaces, by means of a suitable adhesive.

In FIGURES 5 and 6 there are illustrated several further modifications of the present invention, primed reference numerals being used to designate elements corresponding to those of the previous embodiment. Thus, there is provided a main sheet **10'** having a plurality of generally columnar-shaped hollow projections **12'**, and a second substantially unshaped or flat sheet **16'**, the difference between the embodiments of these figures and the preceding embodiment being that the bleed or vent openings are provided in the sheet **16'** rather than in the sheet **10'** having the projections thereon, as indicated at **18**. As will be appreciated, this embodiment functions in exactly the same manner as do the previously described embodiments. In FIGURE 5 the two sheets **10'** and **16'** are illustrated in unsealed relationship, wherein they may be loosely positioned in contact with each other, or attracted to each other by their retained static charges, depending on the type of material from which they are formed. In FIGURE 6, they are illustrated in heat sealed relationship with each other, in exactly the same manner as were sheets **14** and **16** in FIGURE 4.

In FIGURE 7 there is illustrated a high capacity cushioning material comprising two specially formed sheets **10** positioned together in a back to back relationship. The manner in which such an embodiment functions is exactly the same as above, except that a greater cushioning capacity is provided. It is not essential that the corresponding projections **12** on each of the sheets be in axial alignment with each other, as illustrated, since each projection may define an air pocket either in conjunction with a corresponding projection on the other sheet, or in conjunction with the substantially flat surface portion thereof. Furthermore, the two sheets may be either loosely positioned with respect to each other, heat sealed or secured together in any desired manner, or maintained together by their inherent static attraction. In addition, if the two sheets are arranged in the manner illustrated in FIGURE 7, the vent or bleed holes **14** in one of the sheets may be omitted.

While all of the embodiments disclosed herein are illustrated in a substantially flat position, it should be realized that if desired they may be formed in various contours to fit specially shaped articles to be protected. In addition, the cushioning material may be formed originally in a substantially flat form so that it may be wrapped around an article to be protected when it is packaged, the latter being probably the most likely application of the invention. Furthermore, the various projections may be formed of differing heights in a given sheet and/or may be either regularly or irregularly spaced from one another, depending on the desired cushioning effect to be obtained.

Thus, there is disclosed in the above description and in the drawing, several exemplary embodiments of the present invention which fully and effectively accomplish the objects thereof. However, it will be apparent that variations in the details of construction may be indulged in without departing from the spirit of the invention as herein described, or the scope of the appended claims.

What is claimed is:

1. A cushioning material comprising a first sheet of resilient thermoplastic film material of the type characterized by its retention of a static charge, said first sheet having a plurality of generally frusto-conical hollow projections formed therein, all of said projections projecting outwardly from one side of said sheet in the same direction and including a frusto-conical side wall portion and a planar end wall portion, means defining a flow restricting vent opening in said planar end portion of said projections, and a second sheet formed of a thermoplastic film material also having static charge retention characteristics, said second sheet being disposed in contact with the other side of said first sheet whereby a plurality of air pockets are defined between said first and second sheets by said hollow projections, said first and second sheets being attracted to each other by their retained static charges.

2. A cushioning material as claimed in claim **1**, wherein said second sheet has a plurality of generally frusto-conical hollow projections formed therein, all of said last-mentioned projections projecting outwardly from one side of said second sheet in the opposite direction as said projections on said first sheet.

(References on following page)

References Cited by the Examiner

UNITED STATES PATENTS

Re. 24,062	9/1955	Horton	215—1
201,062	3/1878	Smith	154—55 XR
263,531	8/1882	Kacer	154—55
355,140	12/1886	Cole	154—55
1,166,811	1/1916	Bowers	182—137 XR
1,627,935	5/1927	Stinchfield	96—87
2,045,384	6/1936	Gerb	154—45
2,391,997	1/1946	Noble	154—45.9
2,575,764	11/1951	Morner	156—292
2,633,442	3/1953	Caldwell	156—210
2,679,969	6/1954	Richter	229—3.5
2,851,390	9/1958	Chavannes	156—292

3,003,599	10/1961	Rubissow	154—45
3,142,599	7/1964	Chavannes	161—131 XR

FOREIGN PATENTS

70,088	10/1949	Denmark.
1,175,906	11/1958	France.
1,245,009	9/1960	France.
1,245,096	11/1959	France.
551,733	3/1943	Great Britain.
829,945	1/1952	Germany.

EARL M. BERGERT, *Primary Examiner.*

CARL F. KRAFFT, ALEXANDER WYMAN, *Examiners.*