

May 4, 1971

T. G. HINES ET AL

3,577,305

THERMAL AND AIR SHOCK INSULATING STRUCTURE

Filed Aug. 22, 1968

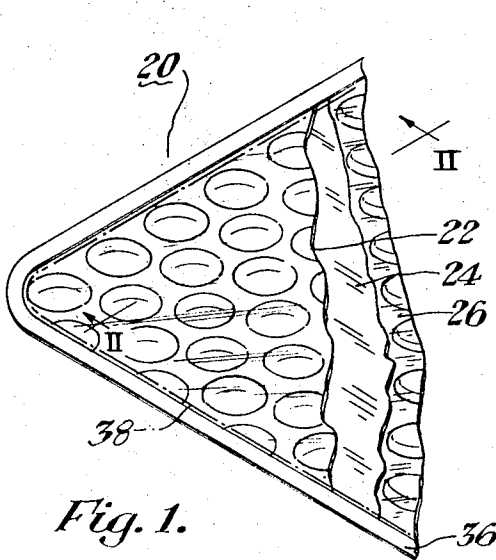


Fig. 1.

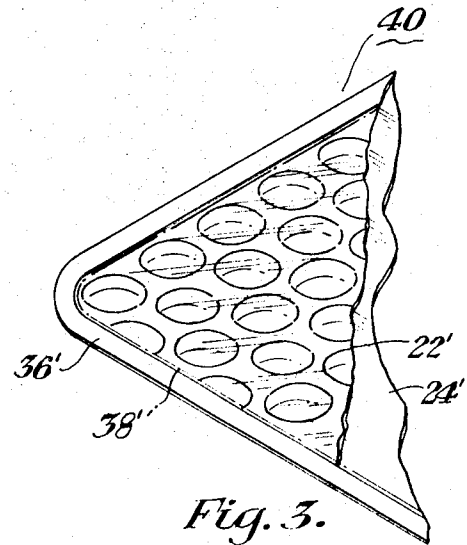


Fig. 3.

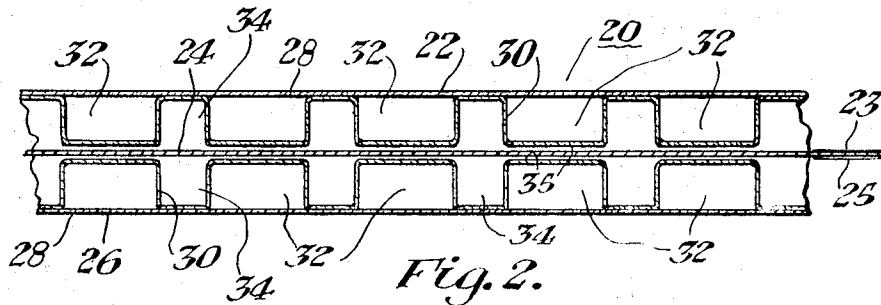


Fig. 2.

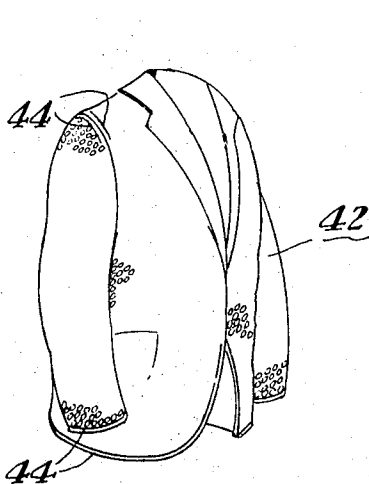


Fig. 4.

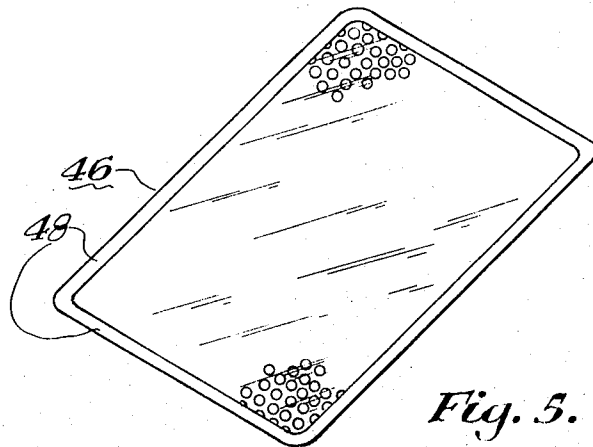


Fig. 5.

INVENTORS
Theodore G. Hines and
Wayne C. Engle.
BY *Bull, Shults & Zierlein*
THEIR ATTORNEYS

1

2

3,577,305

THERMAL AND AIR SHOCK INSULATING STRUCTURE

Theodore G. Hines and Wayne C. Engle, both % Pine Instrument Co., 322 Oak St., Grove City, Pa. 16127

Filed Aug. 22, 1968, Ser. No. 754,534

Int. Cl. B32b 3/12, 15/08; A41d 31/00

U.S. Cl. 161—4

10 Claims

ABSTRACT OF THE DISCLOSURE

There is disclosed a flexible thermal and shock insulating structure which can be fabricated substantially from layers of plastic material. At least two of the layers are sealed to form a multitude of dead air cells. A reflective member is placed adjacent the dead air cells, and the assembly thus formed is sealed along its peripheral edges to prevent entry of dirt or other foreign material and deterioration of the reflective quality of the reflective surface. The air cell material and the reflective member are not otherwise joined, with the result that the assembly retains sufficient flexibility for use in manufacturing articles of clothing or the like. The assembly is further arranged to present a relatively smooth outer surface for protection of the sealed air cells and to enhance the qualities of the assembly for use as clothing or as other insulated articles subject to relatively rough handling and usage.

The present invention relates to a sealed multilayered insulating assembly and more particularly to an assembly of the character described which is light in weight, has excellent thermal and shock insulating properties and is relatively thin. These characteristics of our novel insulating material render it most appropriate for use in fabricating articles of clothing or for other personal usage such as insulating cushions, sleeping bags and other coverings.

For extremely cold weather conditions, it is essential, of course, to provide well insulated outer garments, sleeping bags, mattresses, and other coverings. In addition to the insulational characteristics of such garments or coverings under cold weather conditions, it is frequently highly desirable to afford such garments or coverings with shock absorption such as available from various types of air cushioning means.

Previous efforts in this direction have resulted in extremely bulky outer garments, cushions or other coverings, which in addition usually entail considerable weight. The advent of relatively light weight synthetic fabrics and the like have alleviated the weight problem to some extent but have not substantially reduced the bulk required in well insulated outer garments and other coverings. Nor have such fabrics and other insulational materials overcome the tendency of these to become permanently compressed after repeated usage, particularly in the case of mattresses, cushions and footwear. Such compression, of course, substantially eliminates the relatively static air spaces within the insulating material which theretofore had afforded the insulating characteristic.

We overcome these disadvantages of the prior art by providing a multi-layered insulating material or assembly of relatively small overall thickness. Our assembly moreover is extremely light in weight in contrast to its pronounced thermal and shock insulating characteristics. Our insulating assembly is further provided with sealed dead air cells such that the insulating characteristic of the air contained therein cannot be disturbed by the wearer's and user's movements or anticipated loading of the assembly. The assembly most importantly is arranged such that the air cells cannot be punctured or permanently compressed during normal usage of the assembly.

Specifically, our novel insulating structure, in addition to its cushioning properties, minimizes to a marked degree the transfer of heat therethrough by either radiation, convection or conduction.

We are, of course, aware of the efforts of others in this field. The United States patent to Gazelle 2,221,310 discloses a fabricated insulation having an embossed transparent sheet adhered to a layer of metal foil which in turn is adhered to a paper backing. The Gazelle insulation, although useful for its intended purposes, does not meet the problems solved by our invention. The referenced insulation exposes the protruding air cells, which are therefore easily punctured or otherwise damaged. Moreover, the paper and metal foil which completes the air cells are easily punctured. The roughened surfaces of the Gazelle insulation makes it difficult for use in fabricating garments or for various types of cushioning and other insulating devices.

Schuetz 2,179,057 discloses a heat insulation having multiple layers of felt used as sheathing, roofing or building paper. Although certain forms of the Schuetz insulation provide smooth surfaces, his structure is inherently stiff. While the insulating properties may be relatively good, the inflexibility of the Schuetz structure renders it unfit for garments and various cushioning devices requiring materials of light weight and the utmost in flexibility.

Williams 1,875,188 discloses a honeycombed insulating structure, the air cells of which are closed by an aluminum foil. The air cell structure is rigid and untransparent, which considerably reduces reflection of radiated heat by the foil. The foil can be punctured easily in deterioration of the insulation afforded by the air cells. As in the Schuetz reference, the Williams structure obviously is not suitable for clothing or cushioning purposes.

Of interest also is the patent to Struycken de Roysancour 3,219,514 which discloses embossed textile materials for use as clothing. However, the air spaces enclosed between the fabric layers are not dead air spaces and there is no reflective material. Thus, the initial advantage of such air spaces rapidly disappears during use, and obviously the Struycken de Roysancour device offers little service for cushioning or shock insulating purposes.

We accomplish these desirable results by providing a thermal and shock insulating structure comprising a layer of sealed air cell material, a reflective member substantially co-extending with said layer, said layer having substantial light transmittance, and the peripheral edges of said reflective member being sealed to the peripheral edges of said layer to prevent the entry of foreign matter and to provide additional air cells of a semi-closed character between said layer and said member.

We also desirably provide similar insulating structure wherein the sealed air cells protrude entirely inwardly of the outer surface of said structure and define additional air spaces therebetween closable by said reflective member.

We also desirably provide similar insulating material wherein said reflective member is a plastic sheet having a metalized coating on that side juxtaposed to said layer, and the edges of said sheet are heat-sealed to said layer edges.

We also desirably provide similar insulating structure wherein said reflective member is provided with a reflective surface on each side thereof and disposed between a pair of said layers, and each of said layers is capable of substantial light transmittance.

We also desirably provide a thermally insulating cushion and the like comprising at least one layer of sealed air cell material, a reflective member having a reflective surface juxtaposed to protruding air cells of said layer,

3

said member being peripherally joined to said layer but otherwise loosely engaged therewith.

We also desirably provide a thermal and shock insulating garment comprising at least one layer of sealed air cell material, a reflective member having a reflective surface juxtaposed to protruding air cells of said layer, said member being peripherally joined to said layer but otherwise loosely engaged therewith.

During the foregoing discussion, various objects, features and advantages of the invention have been set forth. These and other objects, features and advantages of the invention together with structural details thereof will be elaborated upon during the forthcoming description of certain presently preferred embodiments of the invention and presently preferred methods of practicing the same.

In the accompanying drawings we have shown certain presently preferred embodiments of the invention and have illustrated certain presently preferred methods of practicing the same, wherein:

FIG. 1 is an isometric view of one form of insulating material arranged in accordance with our invention;

FIG. 2 is an enlarged cross sectional view of the material shown in FIG. 1 and taken along reference line II—II thereof;

FIG. 3 is another partial isometric view showing a modification of our invention;

FIG. 4 is a side elevational view of a typical garment constructed from our material; and

FIG. 5 is an isometric view of a seat cushion, mattress or similar structure constructed from our novel material.

Referring now more particularly to the drawings and initially to FIGS. 1 and 2 thereof, our novel insulating structure 20 is arranged for maximum thermal and shock insulating characteristics. In this arrangement of our invention, a very light-weight and a very thin insulating structure 20 includes a first layer 22 of sealed air cell material, a metalized plastic sheet or metallic foil or other reflective member or layer 24 and a second sealed air cell layer 26. In this example each layer of air cell material 22 or 26 can be formed from the use of two very thin heat-sealed sheets 28, 30 of polyethylene or the like, and is commercially available from Sealed Air Corporation, Hawthorne, N.J. The individually sealed air pockets 32 can withstand heavy compression without puncturing or permanent deformation.

In the insulation structure of FIGS. 1 and 2 at least one of the air cell layers 22, 26 is of substantial light conductance, and the reflective member 24 is provided with a reflective surface at least on the side thereof adjacent the layer 22 or 26, either or both of which can exhibit substantial light transmittance. Desirably the central or reflective layer 24 is provided with a metalized coating 23 or 25 or as otherwise formed with a reflective surface on each side thereof, and each of the layers 22 or 26 exhibits substantial light transmittance. In the case of the very thin polyethylene sheets 28, 30 the layers 22, 26 have at least a semi-transparent character.

The air cells 32 of each sealed air cell layer 22, 26 are relatively closely spaced to minimize transfer of heat by convection or conduction through the insulating structure 20. On the other hand the light transmittance associated with these layers, when both are capable of substantial light transmittance, minimizes heat transfer by radiation at either side of the central or reflective member 24, when the member is provided with a reflective surface on either side thereof. The structure 20 maximizes the reflection of bodily heat for example, to the user, when the structure 20 is made into a garment, cushion, sleeping bag, mattress or the like.

Thermal conduction or convection is minimized still further by additional, semi-closed air cells 34 within the insulating structure 20. The air cells 34, although not dead air cells, are substantially enclosed by the surrounding and protruding dead air cells 32 mentioned above and

4

by the adjacent reflective member 24. In the insulating structure 20 of FIGS. 1 and 2 the thermal insulating character thereof is further increased by the provision of semi-closed air cells 34 on either side of the reflective member 24. By the same token both the thermal and shock insulating characteristics of the insulating structure 20 are enhanced by the provision of the dead sealed air cells 32 on each side of the reflective member 34.

Most important to the life of the garment, cushion or other insulating device fabricated from the multi-layered structure 20 is the smoothness of the outer sheet 28 of each air cell layer 22 or 26. This prevents the dead air cells 32 from being ruptured by inadvertent contact with external objects or by engaging the wearer or user of the material. Moreover, compressive forces of long duration exerted upon the insulating structure 20 do not rupture the dead air cells 32 nor leave them in a state of permanent compression. Thus, the thermal and shock insulating characteristics of the structure 20 are preserved throughout the life of the material.

The loose engagement between the blunt, inwardly facing surfaces 35 of the air cells 32 with the adjacent reflective surface of the reflective member 24 maintains the latter in a well polished condition for maximum reflectivity.

To assemble the components 22, 24, 26 of the insulating structure 20 the peripheral edges 36 of these layers are heat-sealed as better shown in FIG. 1 of the drawings. Other means, of course, can be employed for this purpose, such as the use of appropriate cements or glues. When heat-sealing the peripheral edges 36 a more substantial bond between the components 22, 24, 26 results (although not needed in most applications) by removing peripheral portions of the metalized coatings 23, 25 (where the central layer 24 is a metalized plastic sheet), as denoted by chain outline 38 of FIG. 1.

FIG. 3 illustrates a modification of our invention wherein a single sealed air cell layer 22' is juxtaposed to reflective member 24'. The insulating structure 40 of FIG. 3 possesses, of course, the flexibility and smoothness of the previously described structure 20, but still offers substantial improvement in thermal and cushioning characteristics relative to the prior art. It will be understood, of course, that the reflective material 24' can be provided with the peripheral unmetalized portion 38' as mentioned above in connection with FIGS. 1 and 2 of the drawings. When the unmetalized strip 38' is used in the insulating structure 40, obviously such provision need be made only on that side of the reflective member 34' facing the air cell layer 22'.

FIG. 4 illustrates the use of our novel insulating material 20 or 40 as an outer garment such as jacket 42. The various facings or sections of the garment 42 can be individually assembled and sealed as described in connection with FIGS. 1 and 2 or 3 prior to joining by suitable means, for example by heat-sealing their adjoining peripheral edges 44 to form the garment 42. The various facings or sections of the garment 42 preferably are peripherally sealed so that individual layers thereof (such as the layers 22, 24 and 26 of FIGS. 1 and 2) are not physically joined or bonded otherwise than at their peripheries 44.

FIG. 5 illustrates the use of our insulating structure 20 or 40 as a novel seat cushion, mattress, or similar device 46. The cushion 46 is sealed at its peripheral edges 48 after the manner shown in either FIG. 1 or FIG. 3. Desirably, the component layers 22, 24, 26 or 22', 24' of the cushion 46 are not otherwise joined.

The insulating structure 20 or 40 of our invention can be used for fabricating many articles in addition to those shown in FIGS. 4 and 5. Other articles of clothing in addition to the jacket 42 can be so made. The insulating structure 20 or 40 can be used in extremely hot climates as cushions, seat coverings, and the like, in which case that reflective coating 23 or 25 of the reflective member

5

24 adjacent the user can be omitted. In cold climates, the insulating structures, such as 20 and 40, can be made into light-weight but well insulated sleeping bags and other outdoor equipment such as tents, cot coverings, and mattresses. In addition to the seat cushion 46 of FIG. 5, the insulating structure 20 or 40 can be used to fabricate automobile seats or seat covers, for example.

From the foregoing it will be apparent that novel and efficient forms of thermal and shock insulating structures have been described herein. While we have shown and described certain presently preferred embodiments of the invention and presently preferred methods of practicing the same, it is to be distinctly understood that the invention is not limited thereto but may be variously embodied and practiced within the scope of the following claims.

We claim:

1. A thermal and shock insulating structure comprising a flexible layer of sealed air cell material, a flexible reflective member substantially co-extending with said layer, said layer having substantial light transmittance, and the peripheral edges of said reflective member being sealed to the peripheral edges of said layer to prevent the entry of foreign matter and to provide additional air cells of a semiclosed character between said layer and said member and between adjacent ones of individual cells of said layer, said air cell material being oriented relative to said reflective member so that said individual cells of said layer protrude only toward said member for protection of said individual cells, said individual cells being closely spaced from one another to provide said additional cells between said layer and said member.

2. The combination according to claim 1 wherein an additional layer of sealed air cell material is provided, said reflective member is disposed between said layers, at least one side of said reflective member having a reflective surface thereon, and at least that one of said layers adjacent said reflective surface being capable of substantial light transmittance, said additional layer likewise being oriented so that its individual cells protrude only toward said member.

3. The combination according to claim 2 wherein said reflective member is provided with a reflective surface on each side thereof and each of said layers is capable of substantial light transmittance.

4. The combination according to claim 2 wherein said reflective member is a plastic sheet having a metallized coating on each side thereof and substantially co-extending therewith, and the edges of said sheet are heat-sealed to the adjacent peripheral edges of each of said layers.

6

5. The combination according to claim 4 wherein peripheral edges of said coatings are stripped to facilitate heat-sealing to adjacent peripheral edges of said layers respectively.

6. The combination according to claim 1 wherein said reflective member is a plastic sheet having a metallized coating at least on that side juxtaposed to said layer, and the edges of said sheet are heat-sealed to said layer edges.

7. The combination according to claim 6 wherein the peripheral edges of said coating are stripped to facilitate heat-sealing to the adjacent peripheral edges of said layer.

8. A thermal and shock insulating garment fabricated substantially entirely from the insulating structure set forth in claim 1.

9. The combination according to claim 8 wherein at least two of said layers are provided and said reflective member is interposed therebetween, the spaced and sealed air cells of each of said layers protruding only and generally toward the air cells of the other of said layers.

10. A thermal and shock insulating structure comprising a pair of flexible layers of sealed air cell material, said layers being oriented so that individual sealed and spaced air cells of each of said layers protrude only and generally toward the protruding air cells of the other of said layers, a flexible member disposed between said layers and co-extending therewith, said member having a reflective surface juxtaposed to the protruding air cells of at least one of said layers, said member being peripherally joined to said layers but otherwise loosely engaged therewith.

References Cited

UNITED STATES PATENTS

2,221,310	11/1940	Gazelle	161—137X
2,410,744	11/1946	Powers	161—139X
2,464,380	3/1949	Daiber	161—69X
2,695,430	11/1954	Wakefield	161—45
2,742,385	4/1956	Bovenkerk	161—45
2,781,820	2/1957	Rogers	2—243UX
3,193,434	7/1965	Weiss	161—69X
3,219,514	11/1965	Struycken de Roysancour	161—131X
3,231,125	1/1966	Sigona	161—214X

JOHN T. GOOLKASIAN, Primary Examiner

R. A. KILLWORTH, Assistant Examiner

U.S. Cl. X.R.

2—243, 272; 161—45, 69, 127, 131, 216