United States Patent [19]

Wiegand

[11] **3,923,293**

[45] **Dec. 2, 1975**

[54] **SPRING INSULATOR FOR WIRE SPRING CUSHIONING STRUCTURES SUCH AS MATTRESSES**

[75] Inventor: **Donald E. Wiegand,** Minneapolis, Minn.

[73] Assignee: **Conwed Corporation,** St. Paul, Minn.

[22] Filed: **June 22, 1973**

[21] Appl. No.: **372,785**

[52] **U.S. Cl.** **267/94;** 5/354; 161/159
[51] **Int. Cl.²** **F16F 3/04**
[58] **Field of Search** .... 267/91, 94, 143, 145, 146, 267/90; 260/2.5 AZ; 161/89, 92, 93, 113, 159; 5/351, 354

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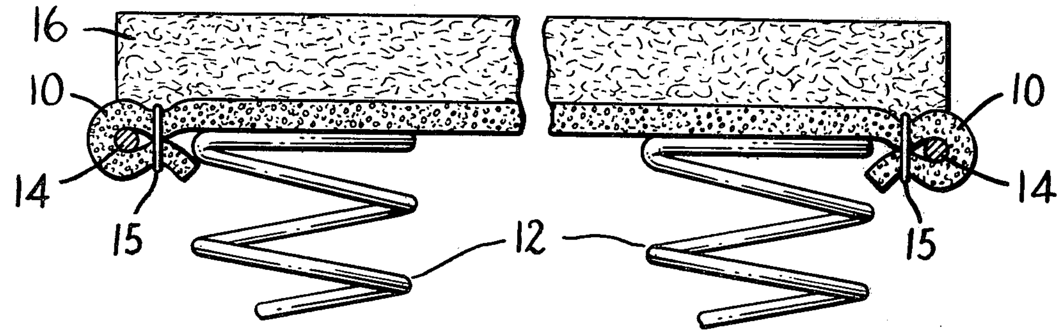
Primary Examiner—Robert G. Sheridan
Assistant Examiner—Ross Weaver
Attorney, Agent, or Firm—Eyre, Mann & Lucas

[57] **ABSTRACT**

A spring insulator in the form of a specified flexible polyethylene plastic foam sheet is provided for wire spring cushion structures such as are employed in mattresses for preventing the soft cushioning material from dimpling down into the springs and for preventing the objectionable feel of the wire springs from penetrating through the cushioning material. The flexible polyethylene foam sheet spring insulator may be used alone or in combination with other materials such as plastic netting. The polyethylene foam sheet may be provided with means for dampening the sound which may be generated by contact between insulators and wire spring cushioning.

17 Claims, 5 Drawing Figures



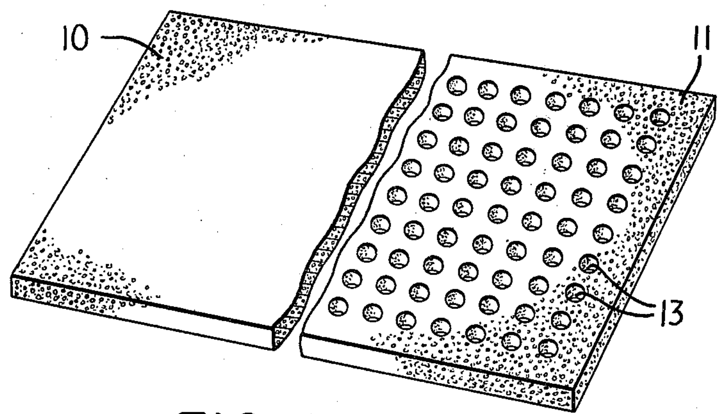


FIG. 1

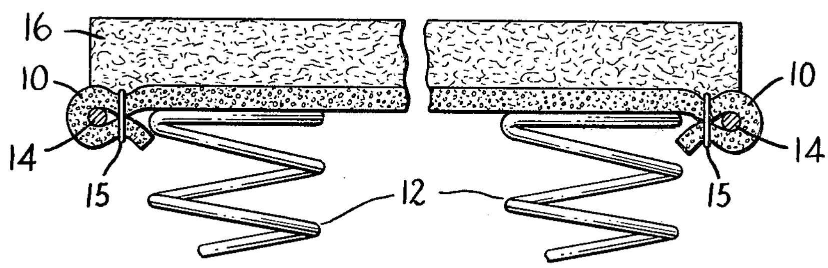


FIG. 2

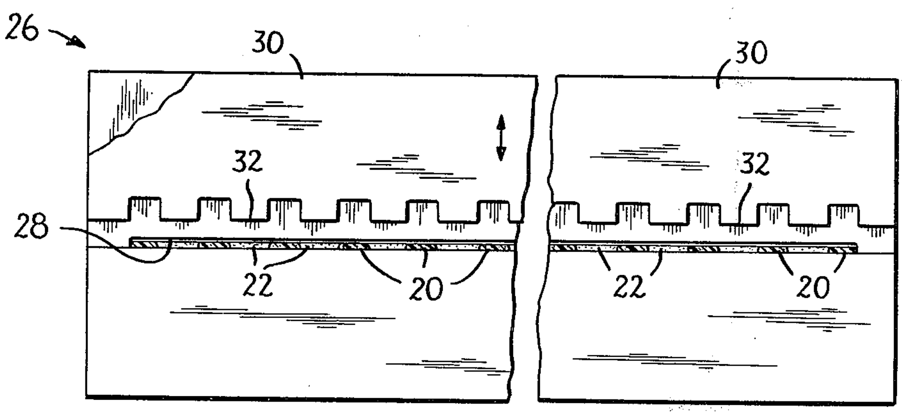


FIG. 3

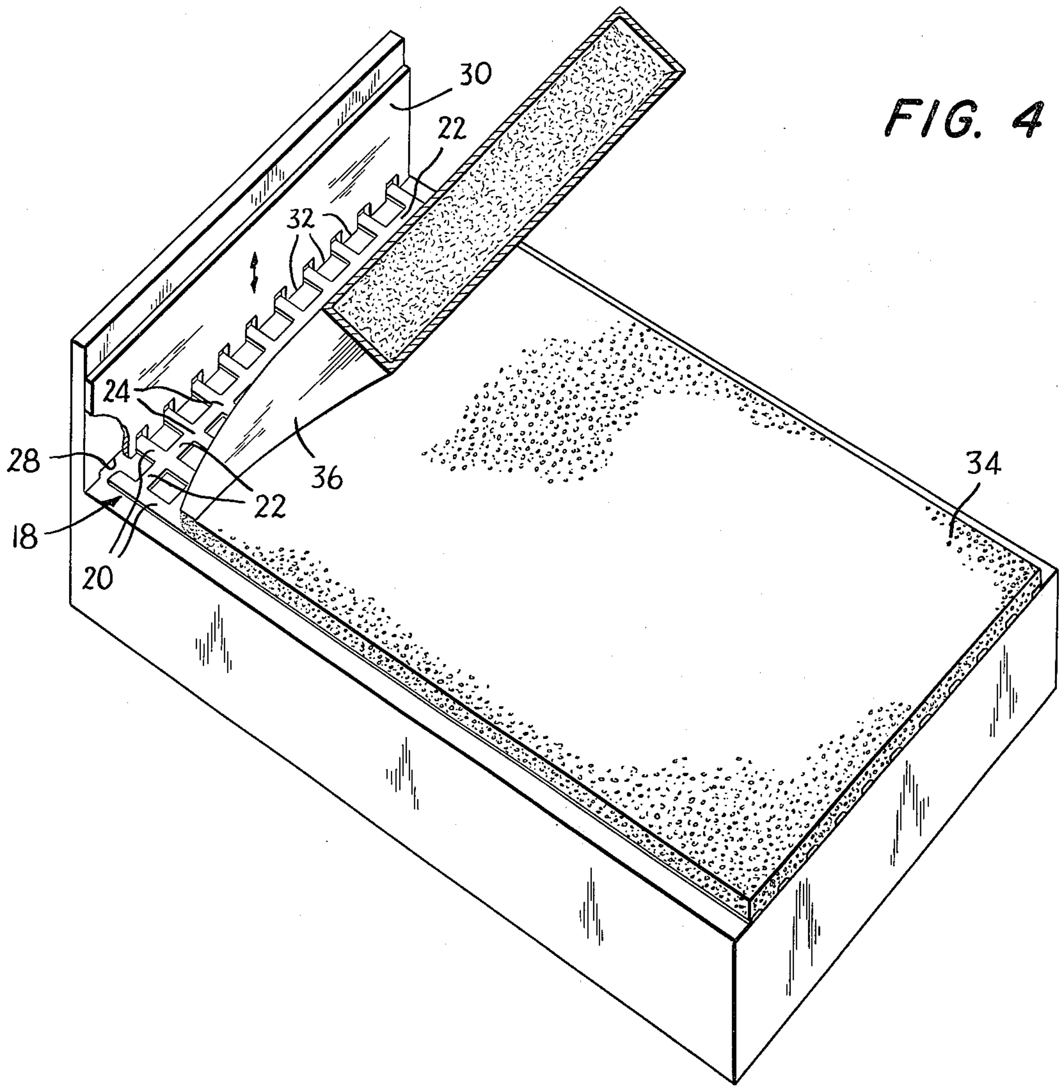


FIG. 4

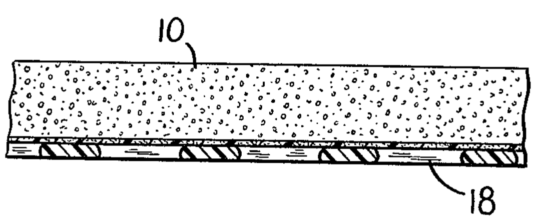


FIG. 5

SPRING INSULATOR FOR WIRE SPRING CUSHIONING STRUCTURES SUCH AS MATTRESSES

BACKGROUND OF THE INVENTION

The known wire spring cushion structures include a foundation of a plurality of resilient metal wire springs usually coil springs which are tied together in the desired configuration within an edge wire border. The top surface or face of this wire spring foundation contains relatively large open spaces between a multiplicity of relatively small wires in the generally planar surface of the foundation. A spring insulator is applied to one or more of the surfaces to form a platform that bridges across the springs and a relatively soft cushioning material is placed on top of the platform. The assembly is completed by some form of outer covering such as a mattress ticking. Such wire spring cushion structures are in wide spread use, as for example, in mattresses, upholstered furniture, automobile seats, office furniture and the like.

The spring insulator is important for preventing the feel of the springs from penetrating through the cushioning material and for preventing the soft cushioning material from dimpling down into the interstices of the springs. A common form of spring insulator is a felted pad consisting of sisal fiber which is obtained from the sisal plant grown in Mexico, Africa and the East Indies. Sisal fiber is a coarse woody fiber. The method of felting a sisal fiber pad tends to create a pad with non-uniform density and as a result, certain portions of the spring assembly may be poorly insulated. In addition, it is well known that a sisal pad tends to stretch and dimple after extended use. Further, a sisal pad generates a very audible rustling noise as the coil springs act under load against the sisal pad surface.

In exploring the drawbacks of a sisal pad, a thin sheet of polyethylene film was placed directly over the springs. The results were not entirely satisfactory because the polyethylene film also generated an objectionable rustling noise when flexing the spring unit.

In working to solve this problem, it was quite unexpected to discover that a polyethylene foam sheet could be used as a spring insulator without any objectionable rustling noise and that the foam could be made to provide advantageous insulator characteristics not heretofore available.

SUMMARY OF THE INVENTION

In accordance with the present invention a polyethylene plastic foam is extruded or molded in a honeycomb type of cellular structure to a density of less than about **6.0** pounds per cubic foot and preferably the density is about **2.0** to **4.0** pounds per cubic foot. The polyethylene foam sheet is made less than about **1.0** inch thick and a sheet only **0.25** inch thick provides an excellent spring insulator. The preferred thickness for the polyethylene foam sheet insulator is from about **0.125** to about **0.5** inch. The specified polyethylene foam sheet has the strength and structural rigidity required for a spring insulator which the ordinary foam cushioning plastics such as polyurethane foam do not possess and at the same time the polyethylene foam is light in weight. For example, a polyethylene foam sheet **0.25** inch thick formed with a density of **2.0** pounds per cubic foot only weighs **42.0** pounds per **1,000** square feet. The weight of the polyethylene foam sheet compares very favorably with the weight of ordinary spring insulators currently in use such as a **0.25** inch thick sisal pad which weighs about **187** pounds per **1,000** square feet and has a density of about **9.0** pounds per cubic foot. As a matter of fact, the specified polyethylene foam sheet is even lighter than a **0.25** inch thick pad of a typical insulator material of felted cellulosic fibers which has a density of **4.5** pounds per cubic foot and weighs about **100** pounds per **1,000** square feet. The specified polyethylene foam sheet is flexible and it will compress but its resistance to compression is greater than that of the usual cushioning and insulator materials and the polyethylene foam has the structural strength required for use as a spring insulator which is remarkable for its weight as compared to other insulator materials currently in use.

The specified flexible polyethylene foam sheet may be made by any conventional process which, in general, is carried out by incorporating a foaming agent into molten polymer which is thereafter expanded and formed in a closed mold or by extrusion. The Dow Chemical Company sells such extruded polyethylene foam under the tradename ETHAFOAM. The Cellu-Products Company of Patterson, North Carolina also sells such extruded polyethylene foam.

Any conventional cushioning or upholstery material may be employed in combination with the specified polyethylene foam sheet such as cotton batting, polyurethane foam and the like. The softness, thickness and physical characteristics of the pad of cushioning material will vary depending on the product at hand. A preferred cushioning material for mattresses is a loosely carded or garnetted batt of cotton felt which contains no binding agent or adhesive. The mattress pad of cushioning material is usually between about **0.25** to **1.0** inch thick with a density of about **1.5** to **4.0** pounds per cubic foot.

In forming the spring cushion structure, the polyethylene foam sheet of the present invention may be bonded to the cushioning material or to the wire springs or to the spring unit edge wires. The bonding may be carried out mechanically as by stitching, stapling or by wire or plastic filament ties. If desired, adhesives may be employed as described for example in U.S. Pat. No. **3,315,283.** However, the polyethylene foam sheet has sufficient structural rigidity so that it need not be bonded to the springs or cushioning material and in such case the ticking or other outer covering will be relied on to hold the foam sheet in place in the assembly. The polyethylene foam sheet spring insulator may be employed to cover selected areas in the wire spring cushion structure but best results are achieved by covering the entire wire spring area.

In some applications, it will be of material advantage to use a net such as cotton or plastic net in combination with the flexible polyethylene foam sheet of the present invention. The net will reinforce the polyethylene foam sheet and tend to prevent any creeping of the sheet within the spring cushion assembly. For best results, a plastic net is employed such as any one of those currently in use as spring insulators. As described in U.S. Pat. No. **3,315,283,** the plastic net may be formed by extrusion of polyethylene or polypropylene strands integrally bonded together at the cross-over points. The strands in the net are oriented by heating and stretching to provide a stretch resistant open mesh spring insulator. The size of the strands and openings in the net may be varied depending on the desired strength. For example, the plastic net may have about 4 strands per linear inch and weigh about **7.0** pounds per **1,000** square feet. The net itself may be formed of an adhesive material that will bond to the metal springs such as Surlyn-A as described in U.S. Pat. No. **3,576,040.** The net may be positioned in the body of the polyethylene foam sheet but it is preferably bonded to one or both faces of the foam sheet in any convenient manner as by adhesive or mechanical ties such as staples, wire or stitching.

In a modified embodiment of the invention, the netting is placed on the surface of the polyethylene foam sheet and secured to the foam by applying a thin paper like sheet of tissue coated with a conventional adhesive to the surface of the net which is sandwiched between the tissue and foam. The adhesive penetrates through openings in the net and into openings in the surface of the foam to lock the laminated assembly into an integral structure. The tissue may be conventionally made of cellulose wadding or it may be a synthetic fiber carded web such as WEBRIL sold by the Kendall Company.

Alternatively, the plastic net and foam sheet may be extruded as an integral structure by arranging the foam extrusion die and net extrusion die in such a position that the foam and net strands will be brought together in physical contact immediately after leaving the orifice of the die. At this time, the polyethylene strands and foam are still in a semi-molten state and will bond together on contact into an integral structure. Alternatively, the polyethylene foam may be extruded onto the net at a considerable distance from the net orifice after the plastic strands are completely set and the two will still be bonded together since the foam will penetrate the interstices of the net and form a mechanical lock. In the case of cotton net, the polyethylene foam sheet is extruded to encapsulate the net or the foam may be applied as a surface coating on the net.

The polyethylene foam sheet and plastic net may be incorporated into the wire spring cushion structure in any desired manner and the two need not be bonded together or bonded to any other element in the structure. Preferably the net and foam sheet are bonded together and arranged with the net facing the wire springs.

In certain applications and particularly where the foam sheet is attached to the edge wires of the spring unit such as by staples, the foam sheet may tend to act as a drumhead. In these instances a resonance or drum-like noise may be noticeable when spanking the mattress surface with the palm of the hand. This noise is created by the foam sheet momentarily lifting off the springs and then recontacting the springs under the impacting force. This problem may be overcome by incorporating sound dampening means into the structure. One convenient sound dampening means comprises a layer of sound dampening material which is postioned and preferably attached in any convenient known way to a surface of the foam sheet preferably facing the wire coil springs. A layer of fibrous felt is one example of an excellent sound dampening material.

Quite unexpectedly, however, the problem may also be overcome by sound dampening means comprising a plurality of holes positioned in the foam sheet. The holes may be formed in any convenient manner and may range in size from a needle puncture up to an opening of one inch or more in diameter. The polyethylene foam sheet may be pierced with ordinary needles in which case no material is removed from the sheet and the holes tend to close over and become invisible after the piercing instrument is removed. Heated piercing pins may be used and, in this case, the polyethylene foam may melt and leave an open hole. The sheet may be slit and thereafter stretched in transverse direction to open the slits into diamond shaped openings. If the sheet is heated and stretched and then cooled, the openings become fixed and the polyethylene foam sheet will have a net-like configuration. In one example, a standard textile needle felting machine with non-barbed needles was employed to pierce the polyethylene foam sheet with two hundred holes per square inch of sheet surface. As described above, said holes tend to close over after removal of the needles. While this is effective in reducing the drumming sound it is found that even better results are obtainable by providing holes which do not close over. If slits are employed, the vertical walls should be permanently spread apart to prevent contact with each other which produces an objectionable rubbing sound. Thus, a thin slot is preferred over a slit. Open holes that pass all the way through the spring insulator sheet are preferred for sound dampening and these have the added advantage of allowing the sheet to breathe which reduces the tendency for ballooning or floating due to air pressure inside the wire spring foundation.

The size, shape, positioning, depth and number of holes, slits or openings may be varied to produce the desired reduction in the resonance characteristics of the foam sheet. For example, a sheet containing one-half inch diameter holes spaced one inch apart has been found to be very effective in reducing the drumming sound. In general, it is preferred that the holes be round and less than one inch in diameter to prevent the cushioning material from protruding through the holes. Also, it is preferred that the holes provide removal of at least **10%** of the sheet material. However, holes may be eliminated close to the edge wires of the spring unit to allow better staple holding. The maximum amount of material removed by hole placement is governed only by the necessity to maintain the desired insulator function. While it is preferred to punch holes into a solid polyethylene foam sheet, obviously, the same result can be achieved by bonding strips of foam together in a network type of structure. One unique advantage of sound dampening by piercing the sheet with needles is that a fibrous felt layer may be attached to the surface of the foam sheet by using barbed needles for piercing the sheet. In this case, the barbed needles carry fibers from the felt into the pierced holes and as the holes close on themselves the fibers are locked in the foam sheet to hold the felt layer in place. In combination, the sound dampening fibrous felt and holes provide excellent sound dampening in the wire spring cushion structure.

BRIEF DESCRIPTION OF THE DRAWINGS

Further details and advantages of the structure of the present invention may be readily understood by reference to the accompanying drawings which illustrate preferred embodiments of the invention and in which:

FIG. **1** illustrates the flexible polyethylene foam sheet of the present invention without holes in one section and with holes in a second section;

FIG. 2 illustrates a portion of a wire spring cushion structure made in accordance with the present invention;

FIGS. 3 and 4 illustrate the extrusion of polyethylene net as well as the integral structure of polyethylene foam sheet and plastic net;

FIG. 5 is a sectional view that illustrates a flexible polyethylene foam sheet adhesively bonded to a polyethylene plastic net to form a spring insulator structure.

DESCRIPTION OF PREFERRED EMBODIMENTS

Turning now to the drawings, 10 is a flexible polyethylene foam sheet extruded to a density of 2.0 pounds per cubic foot about ¼ inch thick. The sheet 10 was extruded with low density polyethylene and known foaming reagents in conventional manner to form a cell structure that is closed so that water pick up and water vapor transmission is very low. While low density polyethylene is preferred, medium or high density polyethylene may be employed. The usual additives may be added to the polymer such as zinc oxide, stearic acid, pigment, chlorinated paraffins and lubricants and other resins may also be added to change the compressive characteristics of the sheet. If desired, the polyethylene may be cross-linked by a known peroxide cross-linking reagent or copolymerized with other monomers or copolymers, provided that the product has equivalent physical characteristics to the polyethylene foam sheet of the present invention. In a polyethylene foam sheet which contains other resin additives, the polyethylene will in all cases be the major ingredient in the sheet and, in general, only a minor amount of other resin additives will be present. A second polyethylene foam sheet 11 is also illustrated in FIG. 1. The sheet 11 is identical to sheet 10 with the exception of the sound dampening means which comprise openings 13 punched into the sheet.

FIG. 2 illustrates a portion of a wire spring cushion structure such as may be used in a mattress in which a plurality of wire coil springs 12 are arranged in known manner to a desired configuration usually within a wire edge border 14. In accordance with the present invention, the flexible polyethylene foam sheet 10 is placed on the top surface of the springs preferably to cover the entire spring area and provide a spring insulator for the pad of cushioning material 16 which is placed on top of the spring insulator. The cushioning material 16 is a loosely felted layer of cotton fiber without adhesive. Cushioning material 16 may be produced on cards or garnetts in known manner and it is about ¾ inch thick having a density of about 4.0 pounds per cubic foot. The assembly is enveloped by ticking (not shown) which may be relied on for holding the parts in place. In the majority of mattresses the spring insulator 10 is attached to the edge wire 14 and may be attached to the cushioning pad 16 by conventional adhesive or by conventional mechanical ties such as hog rings, cotton stitching or wire ties (not shown). As shown in FIG. 2, the edge portion of the spring insulator sheet 10 is looped over the edge wire 14 and held in place by wire staples 15. The bonding of spring insulator 10 and the cushioning pad 16 into the assembly may be achieved in a variety of known ways and the particular selected method will depend upon the end use of the wire spring structure at hand.

In the structure illustrated in FIG. 2, the resistance of the spring insulator 10 to compression is at least 1½ times that of the cushioning material so that the spring insulator 10 effectively prevents the feel of the springs from coming through to the top surface of the cushioning pad upon compression and the structural strength of the spring insulator prevents the cushioning material from dimpling down into the spring openings. At the same time the spring insulator 10 provides a thickness or filling function which is of advantage in many applications for reducing the thickness of the pad of cushioning material that is required. The thickness of the spring foam insulator 10 and the cushioning pad 16 is adjusted relative to each other to achieve the desired feel in the wire spring cushion structure. While coil springs 12 are illustrated in the drawings, it will be understood that other types of wire springs may be used such as sinuous S springs.

The polyethylene foam sheet spring insulator 11 with the sound dampening means 13 may be assembled in the structure of FIG. 2 in the same manner described for the spring insulator 10.

FIG. 3 and FIG. 4 illustrate the extrusion of a polypropylene net 18 which comprises a first set of parallel strands 20 and a second set of parallel strands 22 that cross the first set of strands at a right angle. The joints 24 at the cross-over of the strands are integrally formed.

One known way in which the polypropylene net may be extruded is illustrated in the drawings. A standard extrusion die 26 with a set orifice opening 28 in the form of a slit is provided with a slide member 30 which is reciprocated in known manner to cause the teeth 32 at the bottom of the slide to periodically interrupt the orifice opening. When the teeth are in position across the orifice opening as shown in FIG. 4, the parellel plastic strands 20 are extruded from between the teeth which seal off spaced portions of the orifice slit. When the slide is raised to remove the teeth from the slit as shown in FIG. 3, a solid strand 22 is extruded at a right angle to strand 20. The extrusion speed of the polypropylene through the die slit and the speed at which the slide of the die is reciprocated are adjusted in known manner to provide a net with the desired mesh openings. An ordinary screw extruder barrel (not shown) feeds the polypropylene through the slit of the orifice and the extruded net is ordinarily passed through a water bath (not shown) and rolled up on a take-off roller (not shown).

The polypropylene net 18 shown in the drawings has 4.6 strands to each linear inch and a unit weight of about 7.6 pounds per 1,000 square feet. The net 18 may be adhesively bonded to the flexible polyethylene foam sheet 10 as illustrated in section in FIG. 5 and the combination of foam sheet and net may be substituted for the foam sheet 10 in the wire spring cushion structure of FIG. 2. In such case, the longitudinal strands 20 are preferably arranged to extend parallel to the wire border edge 14 with the net side of the sheet facing the wire springs. The combination of the foam sheet and net may be bonded to the cushioning material or wire spring structure or both in any desired manner. Alternatively, the flexible foam sheet spring insulator 10 and net 18 may be used in combination in the wire spring cushion structure without being bonded together or bonded to the wire springs or cushioning material.

FIG. 4 also illustrates the extrusion of an integral structure of plastic net 18 welded to a flexible polyethylene foam sheet 34. A standard slit orifice extrusion die 36 is positioned adjacent to the net die 26 to extrude a polyethylene foam sheet in known manner on to the strands of net 18 while the strands are in a semimolten state so that the foam and net strands will be welded and bonded together in an integral structure. The extruded polyethylene foam sheet 34 has the same physical characteristics as the foam sheet 10 as specified hereinabove. In the drawings, the foaming extrusion die 36 is spaced a considerable distance away from the net extrusion die 26 where the two will be integrally bonded by the mechanical lock provided by penetration of the foam into the interstices and around the strands of the net.

For a welded bond, the two dies will, in general, be in juxtaposition to insure an integral welding of the two plastic materials of the net and foam. The integrally bonded spring insulator of net 18 and flexible foam sheet 34 is used in the wire spring structure in place of spring insulator 10 in the manner previously described for the spring insulator of FIG. 5.

In the case of cotton net, the net may be extruded or molded as an integral member in the body of the polyethylene foam sheet in known manner or the foam may be extruded onto the surface of the cotton net.

Other techniques may be employed for forming the polyethylene foam sheet. For example, the foam may be extruded as a hollow tube which may be expanded by air up to three times its extruded diameter and then cooled, slit and unfolded into a flat sheet. The net and foam sheet may also be coextruded as a hollow tube. In such case, separate annular extrusion dies for the net and foam sheet are arranged concentrically in juxtaposition and the two tubes are brought into physical contact immediately after extrusion to weld them into an integral structure. As the tube is expanded by air, the net will be stretched and orientated for greater strength.

It will be understood that the drawings merely illustrate preferred embodiments of the invention set forth in the claims which are intended to cover all modifications which do not constitute a departure from the spirit and scope of the invention.

What is claimed is:

1. A spring cushion structure comprising a plurality of resilient metal wire springs which form a foundation the surface of which contains relatively large open spaces between a multiplicity of relatively small wire therein, a flexible polyethylene sheet of foam of a honeycomb type of cellular structure of less than about 1.0 inch thick with a density of less than about 6 pounds per cubic foot positioned at the top of the wire spring foundation to form a spring insulator for the wire spring foundation and a cushioning material positioned above said spring insulator, the resistance to compression of said spring insulator being greater than the resistance to compression of said cushioning material.

2. The spring cushion structure specified in claim 1 in which the spring insulator is between 0.125 inch and 0.5 inch thick with a density between about 2.0 to 4.0 pounds per cubic foot.

3. The spring cushion structure specified in claim 1 in which the weight per unit of area of the spring insulator is less than the weight per unit area of the cushioning material.

4. The spring cushion structure specified in claim 1 in which the spring insulator in bonded to at least one of the other elements in the structure.

5. The spring cushion structure specified in claim 1 in which a net is positioned on at least one surface of the spring insulator.

6. The spring cushion structure specified in claim 5 in which the net is a plastic net.

7. The spring cushion structure specified in claim 6 in which the plastic net is bonded to at least one of the other elements in the structure.

8. The spring cushion structure specified in claim 1 in which the flexible polyethylene sheet of foam is extruded onto a net and bonded thereto to form the spring insulator.

9. The spring cushion structure specified in claim 1 in which the flexible polyethylene sheet of foam includes sound dampening means.

10. A spring cushion structure comprising a plurality of wire springs which form a foundation, the surface of which contains openings between a plurality of spaced spring wires, a spring insulator comprising a polyethylene foam sheet of cellular structure between about 0.125 and 0.5 inch thick with density of between about 2.0 to 4.0 pounds per cubic foot positioned on said surface of the wire spring foundation and a cushioning material selected from the group consisting of felted fibers and polyurethane foam positioned on said spring insulator, the resistance to compression of said spring insulator being greater than the resistance to compression of said cushioning material and said spring insulator being bonded to at least one of the other elements in the structure.

11. A structure as specified in claim 10 in which the spring insulator includes a plastic net bonded to the flexible sheet of polyethylene foam.

12. The structure specified in claim 6 in which the plastic material in the net is welded to the plastic material of the foam sheet to form an integrally bonded structure.

13. The structure specified in claim 9 in which the sound dampening means comprises a fibrous material positioned on a surface of the foam sheet.

14. The structure specified in claim 13 in which the fibrous material is attached to the surface of the sheet by fibers positioned in interstices in the foam sheet.

15. A spring insulator for a wire spring cushion structure which comprises a flexible polyethylene foam sheet having a top face and a bottom face and being of from about 0.125 inches to about 1.0 inches in thickness and being of a density of less than about 6.0 pounds per cubic foot, said sheet having sound dampening means for reducing the resonance of the sheet, said sound dampening means comprising a plurality of open holes that pass all the way through the sheet from the top face to the bottom face.

16. The spring cushion structure of claim 1 wherein the flexible polyethylene foam sheet has a net positioned on a surface thereof and a paper like tissue covers the net to hold it in place on the surface of the sheet.

17. The spring insulator specified in claim 1 in which a plastic net is associated with the spring insulator in the structure.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,923,293

DATED : December 2, 1975

INVENTOR(S) : Donald E. Wiegand

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 8, Line 1 - Claim 4 - "in bonded" should read --is bonded--

Signed and Sealed this

twenty-third **Day of** *March 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks