ABSTRACT

Cushioned structures, e.g., mattresses, pillows, upholstery cushions, upholstered chairs, or the like rendered fire-resistant by an interliner comprising a fabric coated with a polymeric binder having dispersed therein from 30–60 percent by weight of a flake- or leaf-shaped, heat-conductive material.

6 Claims, 3 Drawing Figures
BACKGROUND OF THE INVENTION

The present invention is concerned with the provision of fire-resistant mattresses and like cushioned structures, such as bed pillows and upholstered furniture. A particularly important application of the invention is the provision of aesthetically pleasing mattress structures that prevent ignition or charring of the interior batting by a lighted cigarette or the like falling on the mattress.

It is well known that many fatal and/or otherwise disastrous fires result from smoking in bed, usually because the smoker falls asleep and his lighted cigarette drops onto the bedding. Unlike flash fires associated with inflammable clothing, a mattress fire is normally slow-developing catastrophe which may involve asphyxiation of the smoker by fumes, together with smoke damage or even total loss by fire of the building involved. The problem is a very serious one, and numerous efforts have been made to develop effective flame-retardant mattress ticking or the like. Thus, for example, it has been proposed that the ticking be made flameproof either by application of various standard flameproofing chemicals to cotton or other ticking fabrics, or by using fibers of inherently flame-resistant polymers such as polyvinyl chloride. The objective of such conventional flameproofed ticking fabrics is generally to prevent ignition of the mattress during relatively short periods of exposure to open flame. In fact, essentially all flameproofed fabrics, e.g., clothing, bedclothes, bedding, protective uniforms, and the like, are designed for short exposures to open flame, the presumption being that the victim, given sufficient protection from a flash fire, will be able to move away from the source of flame in time to save himself.

However, the cigarette falling from the mouth of a sleeper onto the mattress beneath him poses an entirely different problem from those dealt with in conventional flame-retardant fabrics. Thus, in the usual case of fire resulting from smoking in bed, there is long exposure of the fabric to the source of fire, the victim is asleep, and there is a large and concentrated source of combustibles exposed in the batting once the cigarette burns through the bed sheet, possibly a blanket, and the mattress ticking. Neither sheets nor blankets are thought to be significant sources of real danger on most such occasions, presumably because the sheets are horizontal and thin, and the blankets generally of low combustibility, both consequently usually burning only nonspraying holes. It is in the smoldering, fume-producing, and eventually catastrophically flaming mattress batting that the prime hazard most frequently lies.

Similar tragedies sometimes occur when smokers fall asleep in upholstered chairs or sofas.

U.S. Pat. No. 3,512,192 of Simon addresses itself to making a cigarette-resistant mattress by providing, beneath the ticking, a relatively expensive and complex combination of two layers of polyurethane foam with an interlayer of ½ to 1½ inches of Fiberglas matting. The latter, although an unquestionably effective insulator against fire, produces a firmness to which many users will inevitably object. Additionally, as a total departure from today's conventional and mass-produced cotton-and-sisal-padded mattress, this foam and Fiberglas mattress requires acceptance of drastic production and cost changes, always difficult to achieve in commercial practice. A modification which can be easily inserted into the entire range of today's production schedules, as can the interlinings of the present invention, has greater potential for widespread consumer acceptance and use.

Other simpler polyurethane foam-padded mattress constructions, where a nonsmoldering upper layer of foam itself constitutes the barrier against a burning cigarette, have also been developed. While providing mostly adequate protection on those sectors of the mattress where the foam stands free and uncompressed, these structures have locations vulnerable to burn-through anywhere the foam is squeezed and compressed, as along the numerous quilting and other stitchings, edgings and edge rolls, or wherever the foam layer may be structurally discontinuous, as at the junction of top and side panels.

In copending application of Robert E. May, Ser. No. 172,212, to common assignee, it has heretofore been proposed to apply a heat-conductive coating, similar in nature and primary function to the fire-resistant coating of this invention, onto the back of the outer layer, i.e., ticking, of a mattress. Said copending application is hereby incorporated in its entirety into the present application. Though generally highly effective in preventing mattress fires caused by burning cigarettes, there is room for improvement in the coated-ticking method of Ser. No. 172,212, which falls short of meeting commercial requirements when applied to lighter-weight and especially to decorative tikkings. The problem is two-fold: first, the coating shows through to the face side of the lighter-weight tikkings, introducing areas of grayness and interfering with the brightly decorative face patterns; and, second, the coating stiffens the lighter-weight fabrics enough to detract from their hand and comfort features. These defects are especially important in the home market, where aesthetic features are more critical than in the more wear-conscious commercial and institutional market, where heavy-weight long-wearing tikkings are dominant.

In the home market even such problems as the failure of matching mattress and box spring tikkings to match perfectly, one being back-coated and the other not, can create loss of customer appeal and sales.

The principal objective of the present invention is to provide mattresses, pillows, upholstered furniture, or the like which are resistant to ignition by a lighted cigarette and which overcome the aforementioned aesthetic deficiencies of the nearest prior art.

It is a further objective to provide a more universally applicable way to supply both the home and institutional-commercial mattress and upholstered furniture markets with cigarette-resistant structures at increased volume and lower cost.

A further objective is to provide a cigarette-resistant structure which is universally applicable to all types of mattress and upholstered structures, whether based on cotton batting, urethane foam, foam rubber, or other kinds of comfort-affording elements.

Yet another objective is to provide a cigarette-resistant lining which is free of most of the zones of inadequate protection which occur even in heretofore known protected mattress and upholstery structures.

These and other objectives are achieved by the heat-conductive interlinings of the present invention.
SUMMARY OF THE INVENTION

The heart of the invention lies in placing under a mattress ticking or upholstered furniture fabric or, broadly speaking, the outer or enclosing fabric or covering of a cushioned structure, a second layer of fabric coated on at least one side with a film-forming polymeric binder containing a suitable amount of heat-conductive flake- or leaf-shaped material, preferably leafing-grade aluminum or conductive graphite. Stated another way, the invention provides a fire-resistant cushioned structure comprising cushioning means, an outer fabric or other covering member enclosing the cushioning means and an interliner enclosed by the outer fabric and adjacent thereto, the interliner comprising a fabric having on at least one side thereof a coating of a flexible, film-forming polymeric binder having dispersed therein a flake- or leaf-shaped heat conductive material.

The coating herein must have sufficient conductive capacity to carry away the heat of the cigarette fast enough to prevent charring of the interior padding or batting. This capacity appears to be primarily a function of three things: the composition, quantity, and shape of the conductive filler. The nature of the binder does not seem to be critical provided it is inexpensive, odorless, washable, film-forming, and sufficiently flexible to avoid cracking or crackage in use. It is important, too, that the binder retain its flexibility through the life of the mattress.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated by the accompanying drawings wherein the figures represent three views of a conventional cotton-padded mattress, the latter being only illustrative, and not restrictive, of the types of structures rendered fire-resistant by means of the invention. Referring to the drawings more particularly,

FIG. 1 is a top plan view of the mattress;
FIG. 2 is a vertical sectional view of the line 2–2 of FIG. 1, showing the shell and principal structural elements of said mattress; and
FIG. 3 is an enlarged fragmentary vertical sectional view of the mattress showing the ticking, padding, and spring sectors thereof.

DETAILED DESCRIPTION

In its broadest sense the invention comprises a cushioned structure such as a mattress, pillow, upholstered furniture component, or the like including, beneath and preferably essentially separate from the outer covering of the structure, e.g. fabric, film, or ticking, an interliner layer having a coating on at least one side which coating comprises a flexible, film-forming polymeric binder having dispersed therein from 30–60 percent by weight, preferably about 45 percent, of a flake- or leaf-shaped heat-conductive material, finely divided leafing-grade aluminum or conductive graphite being preferred.

Other conventional elements such as springs, sail pads, battings therefore, cottom batting or its synthetic rubber or urethane foam alternatives, and the like, although generally present in some full or partial combination, are only incidental to the invention.

The coating may be applied in equal or other proportions to both sides of the aforesaid interliner. It is preferable to apply all of it to the same side, thereby generally achieving, it is believed, the maximum capability for heat conductance possible from a given amount of the aforesaid flake- or leaf-shaped heat conductive filler, together with the least degree of adverse effect upon the breathability and flexibility of the interliner substrate. While no clear functional difference has been determined between having the coating on the outer or inner surface of the interliner, it is preferable that it be on the inner face, thereby reducing the possibility of its showing through the ticking or upholstery fabric, especially if the latter should be a light-weight or open-mesh structure.

The interliner may be essentially free of or more or less fully laminated to the ticking, but it is preferred, for optimum hand and flexibility, that it be essentially free, except for those places where the two layers may be held together by quilting and other stitching. It is generally preferable that the interliner be placed adjacent to the ticking or upholstery fabric, with the cotton batting or other comfort-providing padding or cushioning beneath the interliner. For better quilting "puff" and softness, however, it may be preferred to place a thin quilting sheet of polyurethane or other foam between the ticking and the interliner. Such quilting foam should, however, be of a type which does not itself constitute a burning or smoldering hazard.

Since the interliner is shielded from exterior contact, it need be neither attractive in appearance nor particularly resistant to wear. It may indeed be made from lightweight, inexpensive substrates having functional and aesthetic characteristics adequate only for the purpose for which they are used; sufficient body to support required amounts of the aforementioned heat-conductive polymeric coating, strength to resist tearing, resilience to maintain its shape over years of use, flexibility to avoid noisy or papery sounds when sat on or lain upon, openness to permit the mattress structure to breathe. Such characteristics are to be found in a variety of woven and non-woven fabrics, and even films, preferably perforated, may be used. In general it may be said that the interliner need only serve its cigarette-resistant function without adversely affecting the appearance, hand, or comfort of the ticking or upholstery layer. Inexpensive woven or non-woven fabrics are generally the interliner substrates of choice.

As is well known to those skilled in the art, a wide variety of mattress and upholstery structures and compositions, catering to an equally wide variety of user tastes and needs, are available in commerce. It is believed that the cigarette-resistant interliner of this invention is equally and easily adaptable to all of these structures. Although its primary potential for use in today's market probably lies in safeguarding the familiar mattress comprising steel coil springs padded equally top and bottom with sial and cotton and encased in utilitarian or decorative cotton ticking, and similarly made and padded upholstered furniture, it is equally effective on urethane foam or rubber mattresses and other cushioned structures, some of which smolder when exposed to burning cigarettes. The universality of the interliner as protection against cigarettes is one of its greatest attractions.

The drawings represent a widely used version of today's all-cotton or part-cotton, part-ficceded mattress, herein detailed as illustrative of the structures in which the conductive interliner of the invention may be advantageously used. FIG. 1 and its limited cross-
sectional view, FIG. 2, depict elements of the mattress discussed herein. The top and bottom of the mattress are bounded by padded outer surfaces a and a', the sides and ends by padded or sometimes unpadded surfaces b and b'. Around the borders, top and bottom, run edgings or weltings generally depicted as c. On top and bottom surfaces (and usually in different shapes on the sides and ends) are quilting stitchings f (see broken lines in FIG. 1). Also showing on top and bottom surfaces are flange stitchings d, resulting from stitching flanges d' to the interior of the top and bottom tickings.

FIG. 3 represents an enlarged fragmentary vertical sectional view of the top half of the mattress showing in more detail various parts of the mattress. Underlying the outer ticking layer g (corresponding to surfaces a and a' in FIG. 2) is an optional but usually preferable thin layer of quilting foam h, the purpose of which is to furnish a soft and visually attractive quilting effect. Below it lies the heat-conductive interliner of the invention, here shown with the substrate fabric i upward and the coating j downward. In the presence of quilting h the facing direction of the coating appears to be truly optional, but as mentioned earlier, with thin ticking and no quilting the coating preferably should face inward. Next comes a heavier layer of cotton batting k, the inner surface of which is usually faced with an inexpensive scrim fabric l. Quilting stitching f usually holds all six of the layers together, both for decorative reasons and to permit unitary layup of the composite layers on the loose sial (n)-coated springs n. The padded tickings on the top and bottom are held taut by flange fabric d, which is stitched on one of its edges, at d', to the underside of the ticking and is usually attached by hookings to the springs n on its other edge.

In the structure as depicted in FIG. 2 the padded top surface a is back-lapped at edging or welling c to side surface b. Since this construction exposes the edge of a, with its unsightly padding layer, to direct view, the edge is conventionally concealed by edging tape e, the whole being held together by a horizontal line of stitching through the entire edging c. Edging tape e is preferably made of fire-resistant of heat-conductive tape. Since surface b carries little load, its structure is normally simpler, frequently being no more than a strip of ticking lightly stitched through a backing strip of conducting interliner to a body-providing layer of batting or foam. Depending upon the degree of bulkiness desired in edging c, the backing for surface b may or may not be carried and stitched into c.

It will be apparent to one skilled in the art that the constructions possible in a variety of mattresses or other cushioned structures are too numerous to detail herein, but that optimum combinations and locations of the conductive interliner of this invention in these various constructions can be readily envisioned.

For example, in previously known mattresses depending upon relatively thick layers of polyurethane foam to cradle a burning cigarette until it burns out, any stitching line which effects compression of the foam becomes a point into which a cigarette is likely to roll and burn through. The flanging stitching line d in such a mattress, or any other type, in fact, is a particularly hazardous location. So too, in many constructions, is the zone between d' and edging c. Unless top surface a be underlaid all the way to edging c with the conductive interliner of the invention, there is special merit in having flange d made of said interliner. This flange is usually present to assure a tight-fitting, non-slipping ticking. When flange d is made of the conductive interliner, even if a cigarette burns through compressed foam and/or un guarded ticking above the flange, the latter either directly holds the cigarette up or, if it falls inside the side ticking, cradles it away from the interior of the mattress until the cigarette burns out.

The conductive interliner also protects the heretofore hazardous quilting depressions, danger areas in foam-protected mattresses because of compression of the foam. The heat conductance of the interliner is just as high at such locations as anywhere else on the surface of the mattress.

The success of the invention appears to be due in considerable measure to the shape, size, and amount of the filler used in the conductive coating. More particularly, the filler should be in leaf or flake from as noted above, i.e., granular and like filler shapes should not be employed for most effective results. Laterally, however, the shape of the flake or leaf may be random in nature.

As noted hereinafter, inexpensive fabrics are the preferred substrates for the interliners of the invention. Either lightweight woven fabrics or various types of non-woven fabrics are useful. Among the wovens are coarse fabrics such as bottom osnaburgs, unbeleached sheeting, tobacco cloth, scrim, and the like. Nonwovens include such structures as the entangled polyester fabrics of U.S. Pat. No. 3,485,706; the spunbonded polyester, polypropylene, and polyethylene fabrics of U.S. Pat. Nos. 3,117,055; 3,117,056; and 3,338,992; and the autogenous-bonded nylon fabrics of U.S. Pat. Nos. 3,516,900; all of these are readily available in commerce under well known trade names.

It has been found that the size of the filler should be in the range of about 50-400 mesh (U.S. Sieve). The optimum mesh size for any particular situation is dependent on such factors as the binder, proportion of filler used, thickness of the coating, other properties desired, e.g., degree of flexibility of the coating, etc. It appears, for example, that a reflected filler size within the range indicated give the best results from the standpoint of heat removal but this must be balanced off with such items as flexibility and ease of application, finer sizes being preferred in the latter respects. As noted earlier herein, the amount of filler in the coating should be in the range of 30-60 percent, preferably about 45 percent, based on the weight of the coating (dried). The weight of the applied coating can be rather widely varied although usually the desired weight will be in the range of 3-5 ounces per square yard of fabric at filler concentrations of about 45 percent. However, coating weights outside this range, e.g., 2-7 ounces or more per square yard, can also be effectively used.

Preferably the coating is applied by knife coating although other modes of application, e.g., spraying, padding or the like, may also be used.

The coating composition as applied should be sufficiently viscous to avoid excessive strike-through of the composition to the front or face of the fabric. To this end, the composition is usually a relatively viscous suspension of the filler and binder containing from 40-50 percent by weight water or volatile organic liquid carrier. Conventional thickeners, stabilizers and/or plasticizers may also be included in the composition to in-
crease the viscosity or stability of the composition and flexibility of the resulting coating. The nature and amount of such additives, if used, can be widely varied and the ultimate selection, for optimum results, will depend on other factors; e.g., whether or not a plasticizer is used depends, at least to some extent, on the nature of the polymer binder and its flexibility. Those in the art can readily determine whether or not the indicated additives need to be used dependent on other operating conditions.

As noted, the filler is preferably flake or leafing aluminum or conductive graphite. A useful form of leaf aluminum is available as grades MD 2100, MD 5100 and MD 7100 (Alcan Metal Powders Division, Alcan Aluminum Corp., Elizabeth, N.J.). These grades pass 99.8 percent through 100-mesh, 99.0 percent through 325-mesh, and 98 percent through 400-mesh screens, respectively. The coarsest grade, MD 2100, appears to give the best results although all three grades are effective for present purposes. Other available types of leaf or flake aluminum may also be utilized. Particularly good results have been obtained using about 100-mesh aluminum flake as the conductive filler with a vinyl binder to give coatings which, when dried, weight around 2 to 7, preferably 3.5 ounces per square yard of fabric, and contain about 45 percent by weight of aluminum based on the dry coating. Obviously, however, other mesh sizes, amounts of aluminum, and amounts of binder may be effectively utilized within the framework of this disclosure.

In the case of graphite, it is essential that this be conductive if it is to function effectively as the filler herein. Apparently all graphite is fundamentally flake-like in structure, but not all graphite is conductive. Amorphous graphite does not appear to be conductive and, therefore, should not be used for present purposes. A representative example of a suitable conductive graphite is Madagascar flake graphite available as No. 3 graphite (Asbury Graphite Mills, Inc.). Particularly useful results have been obtained using this graphite in a vinyl binder to give coatings which, when dried, weigh around 4-4.5 ounces per square yard of fabric.

Mixtures of flake graphite and aluminum may be used if desired although it is usually more convenient to use one or the other depending on the effect desired. In this connection, it is noted that whereas aluminum lays down a bright silvery backing on mattress ticking or the like, graphite gives a dark gray coating, both fillers being resistant to rubbing off when applied as described herein.

It is also possible that other conductive metals in leaf or flake form may be used herein as the fillers. Silver and gold may be mentioned as possibilities although these are generally too expensive to find any wide application.

A wide variety of polymeric resins may be used herein as the binder. This component does not seem to affect the thermal conductivity of the coating but it should be selected to give a coating which is flexible, breathable or porous, durable, elastic, odourless, and otherwise free from properties which would be undesirable for the intended use of the coated fabric. Advantageously, the binder is a film-forming addition polymer of one or more ethylenically unsaturated monomers, e.g., a vinyl or acrylic polymer, the preferred binder being Geon 576, an ester-plasticized aqueous dispersion of a polyvinyl chloride copolymer (Goodrich). Exxon 790, a medium molecular weight polyvinyl chloride homopolymer latex (Firestone), has an advantage from the cost standpoint but presents some difficulties in the preparation of stable suspensions containing the conductive filler. Other useful binders include a commercially available 55 percent aqueous dispersion of a copolymer of about 1 percent ethylene and 83 percent vinyl acetate, protected by a polyvinyl alcohol protective colloid, and Rhoplex HA-8, a self-cross-linking acrylic emulsion. Flexible polyurethanes or other polymeric binders may also be used.

The coating composition used herein is preferably in the form of an aqueous suspension or emulsion since this, generally speaking, gives greater breathability and lower cost. However, organosols or like suspensions of the binder and filler in an inert organic liquid vehicle may also be used.

Preparation of the coating composition, in most cases, involves only a straightforward controlled mixing or stirring together of the binder, filler and vehicle, to obtain the desired suspension. In other situations, however, for example, in the case of Exxon 790, there may be a need for special precautions, such as avoiding excessively vigorous stirring, or blending of the individual components with a surfactant before mixing the components together, in order to obtain a stable suspension (or emulsion) which holds together and does not separate out. Apparently the unsellable flakes or metal or graphite filler can put a fairly heavy strain on the stability of the suspension and care should be taken, in formulating the coating, to maintain the best possible stability.

After the coating composition is applied to the surface of the fabric in the manner described above, the treated fabric should be dried in any convenient fashion, e.g., by hot air or by passage over heated rolls, to dry the coating. Times and temperatures for drying can be varied widely depending on various factors, e.g., the vehicle used, the nature of the fabric, amount of coating compositions applied, etc. However, usually the drying conditions will be in the range of 200-350°F for 1-15 minutes although it will be appreciated that other conditions may also be effectively used.

In formulating the coating compositions used herein, it will be appreciated that the filler, particularly in finer sizes, must be handled carefully to minimize explosion hazards. There is an additional problem in the handling of aluminum and that is its tendency to react and liberate hydrogen under conditions when dispersed in an aqueous medium. Such reaction does not take place if the pH of the system is held between 7 and 8.5, preferably at about 8. The preferred aqueous formulas described herein have a storage life of at least a week when held at the recommended pH, and some mixes can be stored for several months with no noticeable change in performance. Nevertheless, it is preferable, as a safeguard, to store any large quantities of aqueous aluminum binder mix in a ventilated container in a well-ventilated room even if the pH is left within the 7 to 8.5 range mentioned above. Aqueous graphite suspensions do not require this sort of special treatment because of their inertness. In certain circumstances, graphite is preferred for use over a aluminum even though the thermal conductivity of the latter is about one-third greater than that of graphite.
The interliner may also include other conventional treating agents, such as a flame retardant, if this is desired. The heat removal from the locus of a cigarette appears to be so substantial that burning spreads very little regardless of the composition of the interliner itself. Interliner processed according to the invention may be used to make mattresses or upholstered furniture of any desired and well known construction, it being sufficient for present purposes to describe such structures as comprising an encasing outer cover padded with batting. The batting may be cotton, rayon, or other natural or synthetic material.

The cigarette resistance of the interliners of the invention has been determined by the cigarette test. This consists of placing a burning regular size cigarette on a sample of coated interliner and allowing the cigarette to burn out completely. To simulate a padded structure the interliner is backed with conventional cotton batting of the type normally used in mattresses and upholstery. Samples are evaluated by examining the amount of char on the batting after the cigarette has burned out. If the batting is only slightly charred it is ruled acceptable. A large amount of char means the sample failed the test. Test samples used herein were at least 5 x 5 inch. The test is similar in principle to the U.S. "Flammability Standard for Mattresses." Federal Register, Vol. 37, No. 110, pp. 11,362-7 (1972).

As noted before, copending application Ser. No. 172,212 has been incorporated herein, principally to supply details of the formulations and methods of application of the coatings which provide the conductive interliners.

The scope of the invention is defined in the following claims.

I claim:

1. A cushioned structure which is resistant to fire from a cigarette in contact therewith, said structure comprising cushioning means, an outer covering enclosing said cushioning means and an interliner enclosing by said outer covering and adjacent thereto, said interliner comprising a fabric having on the side facing the cushioning means, a coating comprising a flexible, film-forming polymeric binder having dispersed therein from 30-60 percent by weight of flake- or leaf-shaped heat conductive non-amorphous graphite of 50-400 mesh, said coating having sufficient conductive capacity to carry away the heat of the cigarette fast enough to prevent substantial charring of the cushioning means.

2. The structure of claim 1 wherein the weight of the coating is at least about 2 ounces per square yard of fabric.

3. The structure of claim 1 in the form of a mattress comprising said outer enclosing fabric, cushion means within said fabric and said interliner positioned between said enclosing fabric and said cushioning means.


5. The structure of claim 1 in the form of a furniture component comprising said outer enclosing fabric, cushion means within said fabric and said interliner positioned between said enclosing fabric and said cushioning means.

6. The structure of claim 1 wherein said outer covering is a lightweight or open-mesh fabric.